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Gaur bull lowing to his herd,

Photo by M. Krishnan



Wild Life Preservation Society of India

1. The aims and objects of the Society are as follows:—

- (a) To promote interest in and impart knowledge regarding the preservation and conservation of all forms of wild life, particularly among the youth of the country.
- (b) To co-operate with the Govts. of India and States and with other Societies and Institutions having similar aims and objects in working for the interests of wild life.
- (c) To assist in enforcing and actively supporting the Forest Acts, Wild Bird's and Animals Protection Acts and Rules etc. of States and the Indian Arms Act and Rules in so far as they pertain to wild life and to bring to the notice of the authorities any infringement of the same and to assist in the detection and prosecution of offenders in respect of such laws.
- (d) To advise and help the Govt. and wild life administrators in the formation, maintenance and protection of Sanctuaries and National Parks, the preservation of wild life in general and rare species of India in particular and in the introduction of exotic species into the country, the rehabilitation of rare species etc. and in the revision on rational lines of the shooting and fishing rules, so as to conserve and increase wild life stocks.
- (e) To raise funds for the carrying out of the above aims and objects and to found and maintain museums, reading rooms and libraries of natural history in order to disseminate knowledge regarding wild life.
- (f) To promote sportsmanship in shikar and to recognise well regulated shooting and fishing, as a means of preserving wild life and fish so that through wise use the surplus may provide a recreational asset to the nation.
- (g) To carry out publicity and propaganda for the preservation of wild life in India by means of monographs, journals, films, film strips and other feasible methods.
- (h) To assist members of the Society in obtaining shooting and fishing facilities and facilities for viewing and photographing wild life in India.
- (i) To conduct research into the problem of Wild Life management in India, and in pursuance of this, to initiate, encourage and, where possible assist in projects for the study of threatened species and related subjects and to provide reference and research facilities for such work.
- (j) To carry on such other activities which will serve the above subjects.

What membership of Wild Life Preservation Society of India will entitle you to ?

1. You will become an active member of the growing group of Wild Life enthusiasts, who enjoy working for and spreading the knowledge of how to conserve India's heritage of Wild Life for posterity.
2. You will be entitled to the full use of the Library of the Wild Life Preservation Society and of its reading room.
3. You will receive a membership certificate.
4. You will receive personal Identification and Membership card.
5. You will be entitled to buy all publications of the Society at a concessional rate.
6. You will be entitled to buy at concessional rates the Society's Greeting Cards, Calendars, Tie, Lapel badge and the Balance of Nature Game (specially Published in colour for its educative and recreational value).
7. You will be supplied "Cheeta", the quarterly journal of the Society free.

For membership particulars write to Honorary Secretary, Wild Life Preservation Society of India, 7 Astley Hall, Dehra Dun.

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Honorary Secretary.

Inaugural Address at the Fifteenth Annual General Meeting (December 1973) by Shri K.L. Lahiri, I.F.S., Inspector General of Forests

I would have very much liked to be in the listener gallery than in the speaker's podium. For, haven't the Arabs a say: "God has given man two ears and one tongue, so that we listen twice than we speak"? Nevertheless, I consider it a privilege to address you, but briefly; and to acquaint myself with your thinking, so enlightened. Nature conservation, and within its fold wildlife preservation, must come from a social awareness of its value and must be a deliberate social effort to realise it. Your society reflects that awareness and effort, and hence my pleasure to be with you today.

No talk on wildlife preservation in India can be complete without a reference to the 'Project Tiger' which Dr. Karan Singh inaugurated on April 1, 1973. A uniform legislation for preservation and development of wildlife for the whole of India has been passed by our Parliament in 1972. Already, States have adopted the Wildlife (Protection) Act of 1972. We have hopes that with favourable climate created by social efforts by organisation such as yours, other States will also find it possible to adopt it.

I could cite other instances of the executive efforts, with or without the full participation of lovers of nature and wildlife. But these are no laurels on which we can rest. It is only a tiny step taken so far. Discordant voices are not unoften heard that when the average man in India is wild with frustration, plagued with anxiety and despondent with economic situation, why do we need to expend our energy on nature and wildlife preservation? True, there are great difficulties that our economy faces, but let us be prophets of hope and not of doom. Our conscious effort in planning is better living conditions for the average man within the best environment possible. So we can ill afford to let up our aim of higher and higher efforts, lest it is too late. There need be no apologies either.

One should, however, appreciate the fact that forestry itself is only a small part of the Government's activities; nature and wildlife conservation is still smaller. Even though very small, we are fortunate that we have a Prime Minister who considers that even a small step in nature and wildlife conservation will go in a long way to preserve our heritage of varied fauna. We all know of the Prime Minister's keen interest in 'Project Tiger'. I can assure this august assembly that she is no averse to intervening again and again, if she finds that nature and wildlife conservation is not receiving its due share.

For this, however, the enlightened public opinion and the tradition-bound public services will have to be far more dynamic in presenting worthwhile programme. Ideas can have wings, but it would be only a flight to futility, if they are not secured to practical possibilities.

It is in the Second Plan period, we made a start to the scheme on Nature Conservation. We allocated to this scheme about 4.7% of the total expenditure in all forestry scheme. It came down to about 3.8% in the Third Plan and sank to trough about 3.0% in the post-Third Plan period. In the Fourth Plan, the position is only 2.5% of the total outlay in the forestry sector. Nature conservation had always been a State sector scheme. In a federal type of Government, the power of the individual States to determine State priorities is of great significance. But the Central Government have equally a responsibility of correcting any lopsidedness in priorities from the national point of view, and it usually does give a lead in such cases. The concern of the Central Government frequently finds expression through the efforts under Centrally sponsored or Central sector schemes. Nature Conservation has a fit case for such favours, to put it only too mildly. 'Project Tiger' has already been initiated as a Centrally sponsored scheme.

But money is only a small part of the effort. Nature Conservation requires an expertise, which must be built in the Services itself. I was trying to find out what we have done so far in this regard. There may be only 5-6 officers trained in management of wildlife and national parks in the whole of India. Proper utilisation of this expertise and building up further should be a part of our deliberate policy. If there is any reluctance either in authority to utilise the expertise or in the incumbent to prefer a desk job, our efforts towards conservation and development of nature and wildlife or to build up further expertise will suffer in consequence.

Zoological gardens have a great role to play. If they are planned with imagination they can perform great tasks in awakening in young minds an interest in wildlife conservation and a desire to understand the place of nature and wildlife in the totality of man's environment. Even while acknowledging that many of our zoological gardens have done quite a lot in this regard, I cannot but be sad that a fully representative Indian fauna is hardly to be met anywhere.

In the universities too, zoology course has a marked accent on domesticated animals, and at best museum specimens. No study is generally encouraged for wildlife—its ecology and life-habitat. It is not the anatomy of a wild animal and its food habits, but the collective response of wildlife to its environment which should be a more fascinating study.

Wildlife Conservation is an important consideration in human environment and must be an immediate issue with us. But as I said earlier, social consciousness is a significant factor. Public awareness in a democracy is reflected in our Parliament and legislatures. Your Society has done a lot to awaken public conscience, and I would hope that you would continue to strive towards this end. On my part, I would always welcome your constructive criticism and any chance to have frank exchange of views with you.

Communication Among The Higher Animals

THIRD INSTALMENT OF A SERIES

Auditory Communications

M. KRISHNAN

The summer before last, I was in the Periyar Sanctuary, and 50 yards below the rise on which the rest-house was built was a shallow arm of the lake. There was no light to read by, and after dinner I came out and sat on a ledge overlooking the bay. Presently, I heard an extraordinary sound, like a great drum reverberating in a rhythmic throb; it was too dark to see anything, but I knew at once what it was—there was a wild elephant at the water right below me, indulging in one of the many sounds that elephants make, a sound of contentment.

Very soon it was clear that there was not just one wild elephant below me, but an entire herd, and for three hours I sat there and listened to rumblings and grumbings, squeals and gurglings and faint squeaks, deep sighs and an occasional trumpeting, or a querulous "kook, kook, kook" (a call of annoyance), a sharp yapping that proclaimed that an infant was in the herd, dull roarings, and less describable vocal sounds, mingled with the plops of giant feet being withdrawn from the mire, and the sounds of water being splashed and swished about. It was a memorable experience. Rarely was there an interval of silence, and in those three hours I heard more elephant sounds than I have in many years of following the great beasts.

I mention this only to make the point that with our experience of wild animals usually limited to brief chance encounters, and longer observations when they were aware of us, or else to captive specimens in cages and paddocks, it is quite likely, that we do not know all the intraspecific sounds made even by the more familiar of these beasts. For instance, the calls to each other of two striped hyenas out on the prowl, a sharp, querulous call midway between a bark and a mew, has not been described so far by anyone (excepting me). However, we need not feel any inhibitions on the grounds that probably we do not know all the social and personal vocalisations of our animals; we know quite enough.

Naturally, it is in social rather than solitary animals that vocal communications are best developed and most freely used. However, on occasion animals not given to gregarious associations may also be quite vocal, like tigers when seeking a mate, giant squirrels, and muntjac when alarmed. While there is nothing like the dawn chorus of birds among mammals, on occasion some animals may indulge in concerts—the sunset howling of jackals and the early morning whoopings of langur are instances.

Gregarious animals use a number of calls when out together, as when foraging. The great variety of vocalisations of elephants, best heard in the silence and darkness of the night when visual communications are ineffectual, has already been mentioned. Bonnet monkeys in a troop call to one another in low grunts when on the ground (especially when in bush cover) and with a musical, whistled "pio" when in the treetops; dhole chasing quarry through bush country use shrill, short whines to keep in touch with one another; gaur in a herd moo softly or come out with low grunts, and chital and barasingha hinds indulge in a regular conversation of rather plaintive, mewling calls when in cover. All these are fairly low calls, that help the animals in a herd or party to keep together.

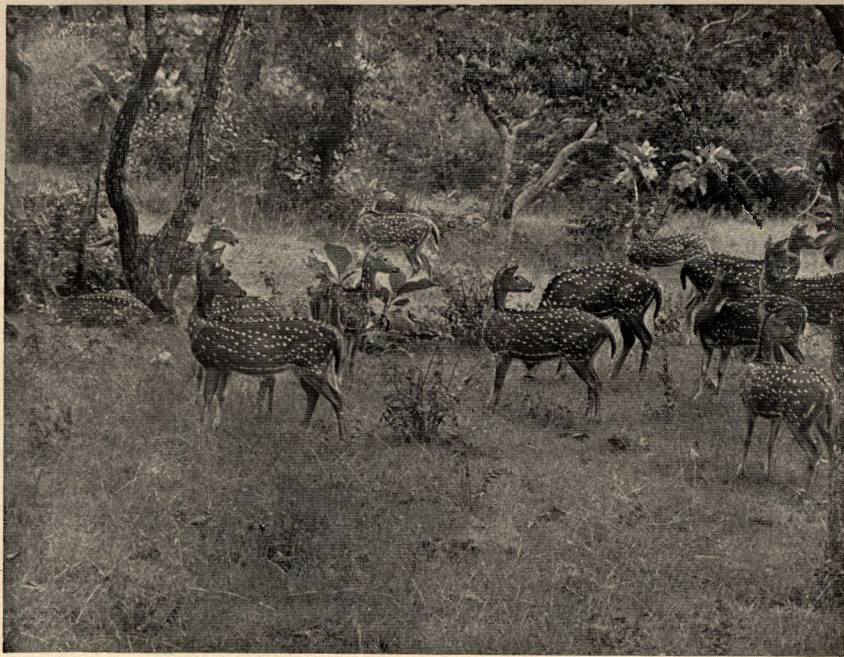
Louder calls are used to reassemble a scattered herd or party. Dhole come out with a weird, loud cackling, reminiscent of the hyena's 'laugh', to reassemble. Elephants trumpet, the calves separated from their mothers roar. One of the most evocative sounds of our hill forests is the long drawn, high-pitched muted lowing of a gaur bull to the herd from which he has been separated, when the herd splits up for some reason, as it does in a sudden downpour. It is somewhat muffled call, not loud when heard from near, but capable of carrying a mile through the forest.

The best known mammalian vocalisations are the alarm calls of various beasts—these are so widely known that they serve not only as intraspecific warnings, but also to warn other animals. In fact, even the alarms sounded by birds are apprehended by many beasts. A peacock's sudden alarm immediately alerted a herd of grazing chital, and every head was at once turned towards the call, as shown in the photograph.

Among the best known of mammalian alarm calls are the frenzied swearing of monkeys (especially of the grey langur) at the sight of a leopard or tiger, the chattering of squirrels, the snort of surprise of gaur, the munjac's hoarse, reiterated bark, and the sambar's explosive 'dhank'. Other deer, too, sound alarms; chital come out with a chorus of high-pitched mewlings, almost of whistles, and barasingha indulge in a sustained, hysterical baying at the sight of a predator.

Chital hinds use a loud, mewling call, with a definite lip-sound to it, to warn another chital of risk apprehended to that other—this is what is known, in telephonic parlance as a 'particular person call', for the warning is addressed not to other chital generally but to a particular individual. All alarm calls are not vocal. The chinkara's sneeze of alarm (from which the animal gets its name) is distinctly nasal and not vocal, as also the gaur's snort. The stamping of the forefeet of deer, and the thumping and clattering of the hooves on the ground at the commencement of the getaway of gaur, and the metallic thud produced by elephants by ramming the trunk sharply against the ground, are all expressions of alarm.

These mutually locative, assembly and warning calls all serve social ends. Many other vocalisations are used in individual communications, and in the expression of moods and



Chital turning their heads and ears towards the sound of a peacock's alarm call.



Chital hind turning towards a human whistle and its echo.

strong emotions. Monkeys chatter and whimper in fright, cats purr in contentment or to announce friendly intent, tigers whine in a low tremulous declaration of friendly or placatory intent when approaching another tiger, dogs yap in excitement, and the repeated alarm calls of many deer are also interrogative, being as much calls of suspicion as of warning.

A great many sounds are used to express anger and hostility: the anger-call of the macaques varies from a reverberating 'krrrrr' to a guttural screech; the lesser cats spit and hiss (as the leopard also does usually), and the greater cats snarl and growl in anger; otters hiss and bark, and members of the dog family snarl; at times elephants shriek in a rage; gaur grunt and snort when combative. Varied as these sounds are, even to human ears they convey hostility and anger unmistakably.

Most personal intraspecific calls, as between mother and young, are low and soft, but a young animal separated from its mother may call loudly to it—young elephants roar at such times, leopard cubs come out with a long-drawn, plangent, hoarse mewling, and as everyone knows, kids bleat lustily when calling to their mothers.

Among birds, we associate song with courtship (and the staking of claim to a territory), and some of the most wonderful music that human ears have listened to have been the songs of birds like the magpie-robin and the shama, the blackbird and the nightingale. Mammals in love are not musical in their vocalisations. In fact, some of the most ridiculous seeming and harsh sounds they make are love-calls. The caterwauling of domestic cats is well known; tigers seeking their mates road fearfully; the blackbuck pursues his chosen doe with rough, eruptive grunts. Once, I saw a pair of courting rhinos on the periphery of a bheel in Assam; the bull was running after the cow with puffing, highpitched grunts, sounds that seemed perfectly ridiculous coming from an animal of his huge size and mass—no doubt they had tender, passionate undertones to that cow rhino. The love-call of the mighty gaur bull is an absurd, muffled piping, produced with enormous effort, and with the head high in the air at the stretch of the neck, much as his call to the scattered herd is produced, except that it is pitched higher and is more of a thin, whistling sound, hardly audible from a hundred yards away.

The ability to locate and identify sounds accurately seems to vary with different animals, but most predators are able to pinpoint sounds faultlessly; animals of the cat and the dog families both have acute hearing, and are far in advance of us in precisely locating what they hear. Most herbivores also are able to locate and gauge the nature of suspicious sounds heard by them, turning their heads towards the noise and switching their ears forward. Nevertheless, occasionally animals may be deceived by confusing sounds. In the Mudumalai Sanctuary, there is a wide nullah and beyond it an almost vertical wall of rock,

and some peculiarity of the formation of the ground here results in a very responsive echo, even to a soft whistle. Coming upon two chital hinds on the farther bank of the nullah, without their being aware of me. I whistled sharply, and at once one of them turned its head towards me, locating me instantly by the sound, while the other turned towards the rockface which had reflected the whistle.

Naturally, since the auditory powers of animals may differ considerably from ours, it is difficult for us to guess how these various vocalisations sound to the animals that make and hear them. The one thing we can be sure of is that nothing so co-ordinated, sustained and tireless as human speech is known to the higher animals.

(To be concluded)

Mistakes in Conservation

PART II

By

SAROJ RAJ CHOUDHURY

HABITAT DESTRUCTION

Effect of unilateral management objectives

May 5, 1969: I was at Jaldiha on the outskirts of the Similipal hills. It was a sandy day. The Kharias had assembled to get their payment for the fledgelings of hill-mynas which they had supplied earlier to the department. The Departmental collection of hill-mynas had been started by me in 1967. The foreign exchange return was high. The Kharia was getting an equally high wage of Rs. 15/- per fledgeling as against one or two rupees which he used to get from the market, prior to 1967.

I was one of their intimate acquaintances. With me their talk was uninhibited. While conversing with them I was thinking: These men in the forest, illiterate and to us appearing unthinking and unknowledgeable, have, nevertheless, been proving how much scrutinising and knowledgeable they are by their intimate association with nature to empirically draw much more probable deductions than all the theoretical application of our foreign book knowledge and immature foreign expertise misjudgements without correlation to reliable local data and field experience.

While talking about the future of Similipal, the Kharias and the Patras got much agitated in expressing their feelings about our ways with these rich forests.

"The sarkar has indeed worked with diligence to see to the complete demolition of the forest trees in the Similipal", they said, "His contractor comes for coupe felling of big trees. Comes then the 'Kelning' (cleaning) contractor, who even does a better job of cleaning the remaining trees in the name of damage and other pleas, and before they finally vacate, they carelessly leave all the debris and slash piled up under the standing trees which are said to be kept to grow up as big size trees in future."With enough pungence the old Kharia satired, "Big indeed those trees will grow! How about it when the fire comes? Go and see how they look, those which the sarkar has left to grow up! Many have charred beyond recovery.....And those elephant forest of Ligirda you remember in the fifties?.....Well, they are now as open as this place where we are sitting. 'Pandu' (frost) has started killing the younger trees in some of the opened out areas. No elephant comes now with the morning sun to the 'Bhuin khajuri' (*Phoenix acaulis*) patches. Heat is growing unbearable during the summer. 'Mohubhandar' (overhanging rock faces

where over 100 hives may be formed at each site) are getting too hot. The big trees with nesting dens for these precious birds (hill-myna) are felled mercilessly. And, our livelihood is at stake."

In his anxiety and disgust, the old man was perhaps exaggerating. But still, I knew, there was much truth too in what he was saying about the steady deterioration of habitat conditions of the integrated living complex because of faulty application and narrow outlook of supposedly sound principles of forest management !

* * * * * * *

Search for a model

In March 1970, I was in Chilla forests, opposite Hardwar, I was searching for a suitable wildlife range as study area for my students. Earlier, I had drawn a blank in the Doon forests. The first batch of my students was expected in April; hence the hurry.

The Chilla forests had been hit by a severe rinder pest in 1906. All the hoofed animals had been virtually wiped out. The range had apparently revived again, because, three decades after the epidemic, Champion mentioned favourably about the status of wild animals here. Three more decades were about to pass by. No one knew the present condition. Local information was noncommittal.

On March 3, I spent much of the day exploring in the neighbourhood of Mundhal Chowki (Forest Guard quarters). There was one 'gujar' (grazier) camp near the Chowki. The 'Lambardar' (camp head man) told me, "Come in the evening. You will see in the flashlight, myriads of glittering eyes all over these open grass lands, only chital chital and sambhar sambhar, any side you look !"

I did not have to wait till the evening. By 3 P.M. I saw the chitals in their separate herds in the 'loafing grounds' and at the edge of the openings, some with their proto-co-operators, the monkeys and the peafowl. The animals were relaxed. The average 'flight distance' was low; in some cases the chital could be approached full view to within 10 metres.

I saw quite a bit of the range during this, my first visit to the Chilla forests. I marked some interesting facets of the range conditions which had apparently gone unnoticed by the land managers.

Effect of artificially induced over population

In the sishum stands nearer the Ganges, there was a peculiar contrast between the segregated groups of tall and healthy old trees and the colonies of young trees repeatedly top broken in recent years to present a pollarded look at an average height of 2 to 3 metres. The local forester wrongly thought it to be the work of the monkeys. To me it was clear that the elephants had done the pollarding.

On my way from Dehra Dun, I had seen the township of the Antibiotics complex near Rishikesh. It stands on the belt of forests that connected the Chilla wildlife range to the more moist and denser forests of the Doon valley to the west. Formerly many of the elephants used to cross over through this corridor to the western moister forests during the summer. They cannot do it now after the establishment of the factory and its township. The seasonal concentration of elephants on the eastern bank of the Ganges—following their age-old practice—and its backlash have affected the sishum, a much lower palatable species; the result of scarcity due to the pressure of overcrowding; a pressure which is ever on the increase because of the influx of more elephants from the forests that are being cleared for large scale eucalyptus plantations to the east, and the natural growth of the resident populations. The evidence is loud in the field, but strangely enough, no one had observed and interpreted it.

Loss of security cover for the ground birds

I saw another peculiar symptom: the sex ratio of the peafowls was two males to one female here as against the expected normal of one male to two females. The peacock spends the night safe on the tree. The peahen and her brood in the ground nest are apparently less protected here than in a normal range. Hence the imbalance; an imbalance which could be easily corrected through simple manipulations of the habitat. It had not been diagnosed, and so, naturally, not remedied.

Benefits of co-ordinated and regulated human use of the habitat

There was lopping of trees by the gujars, many species and all over. The gujar herded his cattle at night, under the freshly lopped trees. I saw the remnants of such lopped material at many places. With the evidence of cattle feeding, there were enough signs of avid use from the lopped branches, by cheetal, sambhar, and sometimes barking deer, nilgai and wild boar too. The woody remains of softwood species had been foraged by the elephants. There were those hoof marks, pellet-groups and the dung boluses to prove the inference.

Here indeed was an interesting case. Every Working Plan Officer had been feeling concerned about this lopping for the past 4 decades. It had been in practice even much earlier than that. The concern expressed in their plans had perhaps kept the lopping under reasonable control. The species of lopped trees, in this land and terrain, have inherently very little commercial prospect. But their leaves brought down annually by man were nutritious food made available to the animals from a level which they could not have reached by their own efforts, not even the elephants. Lopping stimulated the quality and productivity in the leaves. Controlled lopping ensured the future of the stands. And, the lopped matter, besides helping the cattle to produce annually at site, over 6,00,000 litres of milk (30 litres per hectare) had maintained high densities of healthy and well

balanced communities of wild animals. Nowhere had I seen such a dynamic multispecies range so much helped by the coordinated interaction of human influence.

The choice was made. To Mundhal I took my first batch of students for their orientation tour in May 1970. By early April the gujars had left the range for the higher hills. Only one gujar had been delayed to supply milk to our camp. The habitat was left entirely to the wild animals. There was no competition from cattle during the summer time of lean food and water conditions. The cattle would return again in the season of plenty, after the rains.

The forests of Chilla and Khara areas provided my students with the basic orientation. I only drew their attention to the effects of behavioural consequences and other field evidences relating to the dynamic communities of plants and animals, and their inter-relationships. And I stimulated them to reason out the rational inferences, correlate them and take measurements where necessary.

Since 1970 I have been taking every batch of my students to those forests. The second and third batches had been to the same area twice, once in winter and again during the summer.

The symptoms of overuse, the deluge of degradation

Things have changed considerably. The conditions three years back are now past history. The gujars uprooted from the eucalyptus plantation areas have emigrated here in large number. There is mushroom growth of gujar camps. Many stay on during the summer. Cheetals have been ousted from many of their former 'loafing grounds.'

The total number of cattle in the range has increased sharply, but not the total yield of milk. For, as the gujar himself realises, the available nutritious fodder that promotes milk production has to be shared now by a much larger number of cattle. The average yield per milch cattle has decreased to nearly half. The gujar has steadily increased the price of milk. The extra earning pays for the labourer who now brings the lopped material to the camps. No leftovers in such areas are available to the wild animals. And, the gujar's dog runs down young fawns.

One sees to-day many horses mares and foals. The gujar has evidently added horse breeding to his land misuse pursuits. The mares do not yield commercial milk, but weight for weight these equids consume much more of tender grass than the cattle and the wild ungulates, because they are better equipped with incisors in both the jaws but lack the digestive efficiency of the ruminants. The forage resource of this public property will thus be unduly strained with the corresponding gating of the flow of benefits in milk and milk products, plus the fall in the productivity in animal protein (deer species) due to direct competition with the horses. And to add further to this adverse pressure, have come into this range many goats and sheep, the worst browsers and trampers of the habitat.

Increasing social and behavioural stress due to overcrowding of elephants

In this range there is now an increasing influx of elephants whose behaviour has been showing significant changes. Three years back when we met them, it was at first 'novelty' oriented responses, appetitive, ambivalent and compromise through adaptive behaviours—in that order. Sometimes there were even reflex movements on sudden encounters. Towards the end of our stay one herd of 21 and the Mundhal makhna (in musth) had clearly shown advanced adaptive symptoms, to the extent that we could approach within 5 to 8 metres and stay with them for hours together.

To-day, there are more of mosaic movements, agonistic response redirected to the trees and the shrubs, and often its direct release as manifested by actual chase. The social stress is ever on the increase. The behavioural stress has not reached that extreme state of elephants smashing the cars near habitations in broad day light, of holding up and breaking the bus frontage, of taking turns in kicking the tiger's kill for three hours and at the limit of such aberration, grabbing the human being and deliberately tearing and peeling him up to bits and shreds! The day is not far when it may happen here as it already has in the Betla forests of Bihar. How much time does it take in 10 or 20 years when the nation views over hundreds of future years in the concept of 'conservation through wise use'? It warrants bold steps, the inevitable sequel to the now apparent wrong steps that have been taken in the unidirectional projects of disintegrated approach with drastic and far reaching changes in the natural biomes that have and are being caused to result in their isolation from the inherent integral function of the land and its natural biotic communities, including the human being.

Behavioural evidence pointing to the increase in poaching

To-day, the 'flight distance' of the Cheetal is on the increase. Its niches have been spoiled. The range has come to the notice of the poacher. The wildlife populations are losing stability.

In my four hours of lonely walk over 14 kilometres between 7.30 P.M. to 11.30 P.M. on May 6, 1971, I found the Mundhal valley dumb and lifeless. How I craved for the repetition of my experience of May 70, just one year earlier (1) herds of cheetals and many sambhars out in the open by early evening, unconcerned about the flash lights, and the valley resounding with their calls.....What I heard now was the occasional barking of the gujar's dog; what I saw, were the peeping lights from the gujars' camps, and, what I felt was a cramp in my heart.

Physical and mechanical stress of over use

The cheetals and the sambhars have not vanished from the range. They are being forced out to other less suitable locations which must affect them and the land adversely... A range which was shaping as a model of multiple dynamic use, to give positive lead to

the country in the conservation of her renewable natural resource and its purposeful productive management, is fast deteriorating through dissipation by overuse and uncontrolled human interactions including the various types of poaching.

Organised and methodised, under tolerable limits, the human influence is a boon here, and likewise also in any wildlife range in this country. Unrestricted overuse brings the bané, a gradual deterioration in the habitat conditions, often visible in sharp gradients in the unstable sand stone formations like in the Chilla-Khara forests.

My students of the first and second batches, even the third batch, will scarce recognise this range today in February 1973. The loafing grounds of those hundreds of cheetals in Amgadi are lifeless. The tusker that had chased and nearly killed Nihar on December 10, 1970, rules the Amgadi sot. The Mundhal Makhna (Bhisam's pet) is not seen there. The Sarkata and Jogichaur tuskers have become belligerent. The elephants are rarely ever heard snoring at mid day in their deep slumber under the jamun shades in Andheri.....The Mithawali tigress (Mundhal pair) got and lost her cub. The pug marks of Ghasiram and Golawali tigress are not seen in their territories. The Mundhal tiger is untraceable.....The range is being swept clean by heavy overuse.....The nilgais have penetrated deep into that rich cheetal habitat north of Khara-Laldhang road now opened out by heavy grazing. The ambush cover for the tiger is fast vanishing, hill slopes not excluding. The tiger is hampered.....The jackal has entered the range, multiplied and taken to aberrant predation. It thrives on the growing ends of the deer populations, the fawns. And yet, the deer populations continue to increase; for, there is rich food brought down by the gujar, sufficient and spilling over everywhere to wasteful excess.

My students of the earlier courses may remember, I had predicted that there would be steep imbalanced increase in the population of deer species which will soon be followed by landslide deluge here. It is happening now. There are nearly 20,000 cheetals and sambhars alone packed in our study area of about 200 sq. kms, and cattle far more in number than any previous reckoning. About 200 elephants share the range with the ungulates. Over too many hooves and feet are destroying the habitat by sheer trampling, faster than can be guessed. The repetition here of the erosion problems of Hoshiarpur is not far. Mark my warning: It is going to happen unless we tighten our belts urgently, now.

The jackals may retard the growth of deer or an epidemic may sweep through again to pull down the population pressure. It may be conveniently construed as nature's intervention. It would not lead though to the supposedly natural balance, but actual violent long cycled oscillations in future. That would mean mismanagement and not conservation.

The rich potential and the paradoxical impoverishment of the range

I have spelt Chila purposely as 'Chilla' for the Hindi word which means, shout. For this is what the range is doing, with all the force, louder than can be imagined, though

all the numerous signs and symptoms in the field, pointing to its rich potential and exposing its growing poverty !

"Milk, protein, timber, trophy; take it all in ample measures, according to my capacity unending, in perpetuity, with all my non-living and living components unabused, but, please do know how to take it, so that the grassy patches in the chauras are not smothered by unproductive sand dunes." This is what nature is shouting in Chila with all her measureable properties for guidance—she needs help, human help, seasoned by his experience, his intelligence, his forethought guided by simple measurements, commonsense inference and determined approach to stabilise the future.

Surely the mistakes are still amenable to objective remedial measures; not by relegating the range to the passive status of aging morbidity under the nebulous preservation concepts of sanctuaries or National parks, hoping to chase the gujars away, and further hoping piously for nature to take up the repair. That would be unreal and escapist. It would be a grave mistake. The range needs a bold and discreet deal, objective and purposeful, to help it to retrieve its potential to continue to yield multiple and multifaceted benefits, in perpetuity, including to its composite plant and animal communities.

The local man realises with passive resignation

The local man realises it with the raw commonsense of living in that environ. Here is what he feels about the Chila-Khara forests: my talk with two villagers of Khara on December 29, 1971.

"The elephants and the gujars are squeezing into this small area", they said, "The elephants have to, because the living space for them is shrinking due to extensive 'liptus' (eucalyptus) plantations. Food is getting scarcer for such large insurge. And so, you find that they now feed much on what they usually did not even touch a decade back; now forced by hunger."

"Gone are those days sab", wailed the older one, "when the gujar was lopping a tree once every three years. Now he does it every year and cleans up the tree to its last tip. And, he is trying to add new species to his list of loppings."

"The gujars have to do it" he said, "because they are far more numerous now, with many permitted to shift here from those plantation areas where the original forests are being replaced."

"Do you find any change in the behaviour of the elephants ?" Prasad asked them.

In reply, Kesabanand, the young tracker, made a long speech, "There is now a crowding, over too much in comparison to what it used to be only a few years back. The elephants had enough undisturbed areas then for leisurely feeding. Now they have to

move from place to place to avoid the human intrusion. The pity is that, an elephant moving away from one point of disturbance lands up in another with the gujar, the other forest worker, the villager or the shikari whose total number has also increased to unwieldy proportions."

"Some of the elephants ignore human beings; may be they get used," he said, "but many do not. Those form more concentrated clusters, not the useful diffusion that used to happen in those good old days when I was a boy. The result is the increased overuse and consequent deterioration over much larger pockets because the food plants do not get the time for recoupment."

"And how about the tigers and the panthers"? I asked.

Both replied together, "Yes, there appears to be increase in their numbers. That small pugmark on the road side we saw in the morning could be of a tiger cub. But you see, there is certainly quite an increase in panthers. And, there is also more frequent killing of cattle and other domesticated livestock by both panthers and the tigers, more by the panthers." (I remembered the scenes of capture of the monkeys in these forests, the nets and the cages of the contractor's men !)

"Yes sab," Keshbanand had the final say, "if you rush around in the jeep, what would you know about the forest and its animals? We live here with them, and so, we know."

On our way back, N.K. Prasad, one of my students, told me that he could never have suspected of such insight in these illiterate people into the habitat conditions and the functioning of their environ. I was thinking: We are literate, and feel knowledgeable, but, we will never know the real basic problems of our land until we discard our stiff collars and the jeep, to merge with our own people, know our own land and its attributes as they actually are, not as they look through tinted glasses. 'Search images' without the backdrop of reality, lead to confusion with the compound interest of subjective discord. The end of such a pursuit is often worse than the beginning.

Effect of severe ecological changes through exotics

I took the first two batches of my students to the Lalkua eucalyptus plantations of Haldwani Forest Division in Uttar Pradesh. We did not see any wild animal during our field excursions. But from some of the systematic samplings of deer pellet-groups—one pellet-group is a heap or line of droppings in a single defecation—we could reasonably infer that cheetals had been foraging the grass inside the plantations at night, only at the edge of the natural forests. Deeper within the plantations, away from the natural forests, the incidence of pellet-groups was rare or none at all. It was in conformity with the normal behaviour of cheetals. The animals would not go farther beyond the maximum

'flight distance' from the 'escape cover'. The geometric stands of open looking eucalyptus would not provide the visually approved cover conditions. Hence the wastage of fodder inside the plantation.

Unpalatable monocultural stands with drastic qualitative change in the habitat

This exotic has been annually replacing over 4,000 hectares of the natural miscellaneous forests. In its native country, Australia eucalyptus leaves are eaten only by the Koala, a teddy bear-like small marsupial (pouched) animal of arboreal habits. He too shuns the different species of these trees when the prussic acid content in the leaves rises to poisonous level. The gujars complain that a pregnant cow or she-buffalo usually aborts when she by any chance drinks water with eucalyptus leaves in it. Is this true? Does it affect likewise the pregnant cheetal, sambar and others too? The ultimate long term effect of the shed leaves on the soil litter is anybody's guess. None of these have been assessed through any pilot projects. In some of those plantations, we also found the gradual colonisation by lantana, an exotic curse for the forester.

Nearer the Chila and Khara forests, the Rasiabad eucalyptus plantations present similar habitat properties. I have once seen in the morning, a herd of 70 cheetals in one of these plantations. They were trying to hide in a patch of tall grass in an opening inside the plantation, about 100 metres from the edge of the natural forests. When I approached from the forest side they moved deeper away towards another such grassy patch nearer the tractors operating in the new plantation areas. Elephant spoors were seen in the natural forests, none in the plantation.

Change to monotonous pale coloured landscape over vast stretches of formerly colourful natural forests

The symptoms support the reasons for the growing congestion in the Chila-Khara forests. Whatever be the projected economic (doubtful) advantage in the uprooting of the gujars and the elephants by replacing the vast tracts of multi-species natural forests with this single exotic, I have failed to understand why, at least for the sake of natural bio-aesthetics, even if only to break the monotony in the landscape of a uniformly pale looking monoculture, sizeable patches and winding belts of natural forests could not have been left interspersed, unwittingly to continue also to maintain many focii of the more vital inter-trophic (food) webs in natural communities of producers (the plants) and the consumers (the animals). Such pockets and belt-corridors of the natural forests would have provided enough length of dispersed 'edge' and 'escape covers' for better utilisation of the grass available even in the plantations.

Lost the community ingestive and digestive efficiency which used to produce essential animal protein and other products

The grass, forbs and browse foraged on the same land under the natural forests, used to pass through the varieties of digestive systems in those multi-species animal communities often helped by protocooperative or mutualistic micro-organisms to produce animal proteins, milk, trophy and other economic products. All these provided various kinds of employments. The excreta of the animals enriched the soil. If the potential in the quality and productivity had not been realised, it was because wild animals had never been considered as a natural resource which should be made to yield an additional rental equally as high as that from the trees, in some ranges even more than the trees. With the growing recognition of wildlife as a vital renewable resource, the scope for building up that resource is clearly very limited in the same land placed under eucalyptus.

The extent of the cumulative loss in productivity of animals and animal products

This dampening of the animal productivity constitutes an artificially induced loss, the capitalised value of which—loss added up with compound interest every year for all those future years when the eucalyptus stands on that land—should be absorbed, along with other losses, by the economic returns from the Paper Mills. Has this been considered in the comparative evaluations? If not, to me it would appear to be a grave mistake, because unless the future economic benefits from such severe changes in the natural ecological formations were substantially higher for sure by confident evaluation of pilot projects, the drastic change in the social and functional balance of the former communities including the man and the elephants, would never be justified. If on the other hand, the direct and indirect benefits from the Paper Mills with eucalyptus as the raw material were honestly justifiable, the only way to deal with the problem of the uprooted gujars and the elephants was to provide alternative livelihood to the former and operate heavy 'culling' (reduction of population) in the latter, so that the supposedly ultra-development in one region did not cause actual devastation in another as is evident from the symptoms and happenings that I have broadly narrated on the basis of dependable measurements of habitat physiognomy, populations, behaviours, factors and influences in the study areas of Chila-Khara forests.

(To be continued)

Geographical and Altitudinal Distribution of Amphibians and Reptiles in the Himalayas

(PART I)

By

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This paper has been compiled from literature sources in order to provide the biologist with a list of the herpetofauna known to occur in the eastern and western Himalayas. Major works in the literature which deal with the herpetofauna of the Himalayas are ; (1) Smith, M.A. The Fauna of British India. Amphibia and Reptiles. Vol. 1-3. 1935-1943. (The volume on amphibia was never published.) (2) Swan, L.W. Distribution of amphibians and reptiles in the mountains of southeastern Asia. 1947. (3) Swan, L.W. and A.E. Leviton. The herpetology of Nepal: a history, checklist, and zoogeographical analysis of the herpetofauna. 1962. Swan and Leviton, 1962, include a detailed list of the herpetofauna of Nepal and adjacent areas. The present paper differs from Swan and Leviton's in that (1) a number of additional species are listed, (2) altitude ranges have been included, and (3) as far as possible the entire geographical range for each species is mentioned. The reader is referred to the papers by Swan, 1942, and Swan and Leviton, 1962, for discussions on zoogeography of the Himalayan herpetofauna.

The Himalayas may be divided into an eastern and western portion on the basis of rainfall. The eastern Himalayas, for purposes of this paper, include central and eastern Nepal, Sikkim, Darjeeling and northeast Assam. The western Himalayas (much drier than the eastern Himalayas) extend northwest from western Nepal to Kashmir and Ladak. In the following list one asterisk in front of the number of a species indicates that the geographical range of the species in the Himalayas includes both the eastern and western portions. Two asterisks indicate that the geographical range of the species in the Himalayas includes only the western portion. No asterisk means that the species' range in the Himalayas includes only the eastern portion.

As can be seen in Table 1, the wet, eastern Himalayas have a much greater herpetological diversity than do the drier, western Himalayas. Of the 213 species listed, 55% occur only in the eastern Himalayas, 29% occur in both the eastern and western Himalayas, and 16% occur only in the western Himalayas. In terms of diversity, the reptiles are much better represented than the amphibians in the western Himalayas. Approximately 20% of the reptiles are found only in the western Himalayas whereas less than 10% of the

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amphibians have ranges which include only the western portions of the Himalayas.

Table 2 depicts the altitudinal distribution of 199 species of amphibians and reptiles. I was not able to find the altitudinal distribution for 14 species. The crocodiles and turtles of uncertain distribution likely occur in the 0-3,000 foot category. It is of interest to note that the three amphibians found above 12,000 feet do not range lower than 9,000 feet. On the other hand, a number of the reptiles found above 12,000 feet range down to 3,000 feet and lower. Species diversity of amphibians and reptiles does not noticeably decrease until an altitude of 6,000 feet is reached after which there is a sharp decrease for each additional elevation of 3,000 feet.

In the following list the numbers which are enclosed in parenthesis following the altitudinal range of each species indicate the references in the bibliography which were used to obtain the information given for that particular species.

AMPHIBIANS

Order Apoda (Gymnophiona)

Family Caecilidae

1. *Ichthyophis glutinosus* Linnaeus
The Himalayas (Sikkim and Darjeeling), Khasi Hills, Ceylon, Malabar, Indo-China, Sumatra, Java, and Borneo. 6,000-9,000 feet. (11, 12)
2. *Ichthyophis sikkimensis* Taylor
Darjeeling (Rungeet Valley). (23)

Order Caudata (Urodela)

Family Salamandridae

3. *Tylototriton verrucosus* Anderson
Sikkim, Khasi Hills, Yunnan, and N. Thailand. In Darjeeling common from 4,500-5,000 feet, up to 9,000 feet. (11, 13, 21, 22)

Order Salienta (Anura)

Family Pelobatidae

4. *Scutiger sikkimensis* Blyth
Sikkim, Darjeeling, Nepal, N. Burma, and Szechuan-Sikang.
9,000-12,000+ feet. (19, 21; 22)
- **5. *Aelurophryne mammata* Gunther
Kashmir, W. and C. Tibet, and Szechuan-Sikang.
9,000-12,000+ feet, (8, 21, 22)
6. *Megophrys major* Boulenger
Sikkim, Darjeeling, Khasi Hills, N. and Lower Burma, Yunnan, and S.China. 3,000-9,000 feet. (10, 13, 21, 22)

	East Himalayas only		East and West Himalayas		West Himalayas only	Sub-total
Apoda	1, 2.	(2)	-----		-----	(2)
Salamandridae	3.	(1)	-----		-----	(1)
Salienta	4, 6, 7, 13, 18, 30, 31, 35, 36, 40, 41, 44, 45, 48, 50, 53.	8, 9, 20, 29, 32, 33, 37, 38, 42, 43, 46, 47, 51, 52, (30)	10, 11, 12, 14, 16, 17, 19, 21, 22, 23, 25, 27, 34, 39, 49, (15), 11, 7, 13, 14, 18, 21, 22, 23, 25, 27, 34, 39, 49, 51, 52, (23)	5, 15, 24, 26, 28, (5)		(50)
Crocodylidae			54, 55.	(2)	-----	(2)
Testudines	56, 57, (4)	62, 64.	58, 59, 60, 61, 63, 65, 66, 67. (8)		-----	(12)
Sauria	69, 70, 78, 79, 83, 86, 98, 100, 105, 106, (1)	75, 76, 80, 82, 87, 94, 101, 102, 113, (19)	73, 74, 88, 90, 95, 96, 97, 103, 107, 110, 111, 112, (12)	68, 71, 72, 77, 81, 84, 85, 89, 91, 92, 93, 99, 104, 108, 109, (15)		(46)
Serpentes	115, 117, 123, 124, 128, 130, 133, 135, 142, 144, 147, 149, 152, 153, 156, 157, 163, 164, 170, 171, 177, 179, 183, 185, 192, 193, 196, 198, 209, 210, (32)	119, 122, 125, 126, 131, 132, 136, 139, 145, 146, 150, 151, 154, 155, 158, 161, 167, 168, 174, 176, 180, 182, 186, 191, 194, 195, 200, 201, 211, 213, (60)	114, 116, 118, 121, 127, 129, 134, 140, 148, 160, 165, 169, 172, 173, 175, 181, 184, 187, 197, 202, 204, 205, 208, 212, (25)	120, 137, 138, 141, 143, 159, 162, 166, 178, 188, 189, 190, 199, 206, 207, (15)		(100)
Subtotal		(116)	(62)	(15)	TOTAL	(213)

Table 1. Geographical distribution of 213 amphibians and reptiles in the Himalayas. Numbers refer to specific species which are listed in the text. The total number of species for each category is enclosed in parenthesis.

	0-3,000 feet	3-6,000 feet
Apoda	-----	-----
Salamandridae	-----	3. (1)
Salienta	7, 11, 12, 13, 14, 16, 17, 18, 21, 22, 32, 33, 34, 35, 37, 40, 41, 43, 45, 47, 48, 49, 50, 51, 53. (25)	6, 7, 8, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20, 21, 22, 25, 27, 29, 30, 31, 32, 33, 34, 37, 39, 41, 42, 48, 53, (30)
Crocodylidae	-----	-----
Testudines	56, 57, 62, 63, 64, 65, 66, 67. (12)	64. (1)
Sauria	70, 72, 73, 74, 75, 76, 79, 80, 82, 87, 90, 93, 94, 95, 96, 97, 98, 99, 100, 101, 106, 107, 108, 111, 112, 113. (26)	68, 69, 71, 72, 73, 75, 76, 77, 78, 79, 80, 81, 83, 84, 85, 86, 87, 88, 90, 91, 93, 98, 99, 100, 101, 102, 105, 107, 108, 110, 111, 113. (32)
Serpentes	114, 115, 116, 118, 120, 121, 122, 123, 124, 125, 126, 127, 131, 133, 134, 137, 138, 139, 141, 142, 143, 144, 145, 148, 149, 150, 151, 152, 153, 154, 155, 157, 158, 160, 162, 166, 168, 169, 170, 171, 173, 177, 179, 180, 181, 182, 183, 185, 186, 187, 188, 189, 190, 191, 192, 193, 196, 197, 199, 200, 201, 202, 203, 204, 205, 207, 209, 210, 211. (69)	114, 115, 117, 119, 121, 123, 125, 126, 128, 129, 130, 131, 133, 134, 135, 137, 138, 139, 140, 141, 142, 143, 144, 145, 146, 147, 149, 152, 153, 154, 155, 157, 158, 160, 161, 162, 163, 164, 165, 167, 168, 169, 170, 171, 172, 173, 174, 175, 176, 177, 180, 183, 184, 185, 189, 191, 192, 193, 194, 195, 198, 199, 202, 203, 204, 205, 208, 209, 211, 212, 213. (71)
Subtotals	(132)	(135)

Table 2. Altitudinal distribution of 213 amphibians and reptiles in the Himalayas text. The total number for each category is enclosed in paranthesis. Note that a species

6-9,000 feet	9-12,000 feet	12,000+ feet	Altitudinal range uncertain
1. (1)	_____	_____	2. (1)
3. (1)	_____	_____	
6, 10, 11, 12, 16, 17, 18 19, 20, 21, 22, 23, 24, 25, 27, 27, 34, 38, 39, 44, 46. (21)	4, 5, 11, 19, 23, 24, 26, 27, 36, 48. (10)	4, 5, 26. (3)	9, 28, 52. (3)
_____	_____	_____	54, 55. (2)
64. (1)	_____	_____	58, 59, 60, 61. (4)
68, 71, 75, 79, 83, 84, 85, 87, 88, 89, 90, 91, 93, 98, 100, 101, 103, 105, 110. (19)	71, 83, 89, 90, 92, 93, 100, 103, 104, 105. (10)	89, 90, 92, 93, 109, 104. (6)	109. (1)
125, 126, 128, 131, 132, 133, 134, 135, 140, 159, 161, 164, 165, 167, 169, 171, 174, 175, 176, 178, 184, 191, 198, 202, 203, 204, 205, 208, 209, 213. (30)	128, 132, 134, 165, 202, 203, 208. (7)	202, 208. (2)	136, 156, 206. (3)
(71)	(27)	(11)	(14)

(14 are of uncertain distribution). Numbers refer to specific species which are listed in the may have an altitudinal range of more than 3,000 feet.

Altitudinal range uncertain		1000-5000 feet	
7.	<i>Megophrys parva</i> Boulenger	Sikkim, Darjeeling, Khasi Hills, Tenasserim, and Thailand.	To 5,500 feet. (11, 13, 21)
8.	<i>Megophrys minor</i> Stejneger	E. Himalayas, N. Burma, and Szechuan-Sikang.	3,000-6,000 feet. (21)
9.	<i>Megophrys kempfi</i> Annandale	E. Himalayas. Elevation (?).	(16)
Family Bufonidae			
*10.	<i>Bufo himalayanus</i> Gunther	Sikkim, Darjeeling, Nepal, and W. Himalayas.	3,000-9,000 feet. (4, 10, 13, 21, 22)
*11.	<i>Bufo melanostictus</i> Schneider	Sikkim, Darjeeling, Nepal (Chitlong and Soondrijal), Kumaon (Bhim Tal and Naini Tal), Khasi Hills, Yunnan, S. China, Hainan, Indo-China, and the Philippines.	From plains to 12,000 feet. (10, 11, 13, 21, 22)
*12.	<i>Bufo andersoni</i> Boulenger	Nepal, Khasi Hills, W. Himalayas, plains of India, and Mediterranean palearctic.	From plains to 9,000 feet. (21, 22)
13.	<i>Bufo stuarti</i>	E. Himalayas and N. Burma.	0-6,000 feet. (21)
*14.	<i>Bufo stomaticus</i> Lutken	E. Himalayas, Bengal, U.P., and Punjab.	To 5,000 feet. (2)
**15.	<i>Bufo latastii</i> Boulenger	Kashmir.	6,000 feet. (16)
Family Microhylidae			
Subfamily Brevicipitinae			
*16.	<i>Microhyla ornata</i> Dum. and Bibr.	Darjeeling, Kashmir, Khasi Hills, N. and Lower Burma, Yunnan and S. China.	From plains to 9,000 feet. (1, 21, 22)
Family Ranidae			
*17.	<i>Rana cyanophlyctis</i> Schneider	Sikkim, Darjeeling, Nepal. Valley of Valaya (Kumaon), Kashmir, Baluchistan, Khasi Hills, plains of India, Ceylon, S. Arabia, and S.W. and S. Asia.	Plains to 9,000 feet. (1, 4, 9, 10, 11, 12, 13, 21, 22)

(14 are of uncertain distribution). Numbers refer to specific species which are listed in the may have an altitudinal range of more than 3,000 feet.

18. *Rana livida* Boulenger
Sikkim, Darjeeling, Khasi Hills, Assam, Burma, Thailand and Malay Peninsula, Hainan, Tong-king, Tenasserim, and S. China. 0-9,000 feet. (9, 11, 12, 16, 21, 22)
- *19. *Rana liebigii* Gunther
Sikkim, Darjeeling, Nepal, Simla, Kashmir, S. Burma, and S. Yunnan. 3,000-12,000 feet. (2, 4, 7, 9, 13, 21, 22)
20. *Rana annandalii* Boulenger
Sikkim, and Darjeeling. 3,000-9,000 feet. (13, 16, 21, 22)
- *21. *Rana limnocharis* Schneider
Sikkim, Nepal, Kumaon (Bhim Tal), Simla, Kashmir, plains of India, Ceylon, Burma, Thailand, Java, Lombok, Borneo, China, Hong Kong, Hainan, Formosa, and Japan. Plains to 9,000 feet. (1, 3, 4, 9, 10, 12, 15, 21, 22)
- *22. *Rana tigrina* Daudin
Sikkim, Darjeeling, Nepal, Simla, W. Himalayas, plains of India, Ceylon, Burma, Thailand, Malay Peninsula, China, Formosa, Java, Lombok, Borneo, Celebes, and the Philippines. Plain to 9,000 feet. (1, 4, 9, 10, 12, 21, 22)
- *23. *Rana blanfordii* Boulenger
Sikkim, Darjeeling, Nepal, Kumaon, and Simla. 6,000-7,000 feet at Mussoorie, up to 12,000 feet elsewhere. (2, 4, 9, 21, 22)
- *24. *Rana vicina* Stoliczka
Naini Tal and Muree (Punjab). 6,000-12,000 feet. (9, 10, 21, 22)
- *25. *Rana formosa* Boulenger
Sikkim, Darjeeling, Soondrijal (Nepal), W. Himalayas, and Khasi Hills. 3,000-9,000 feet. (9, 10, 21, 22)
- **26. *Rana pleskii* Boulenger
Kashmir and Tibet. 9,000 to above 12,000 feet. (6, 9, 21, 22)
- *27. *Rana alticola* Boulenger
Kashmir, Assam, Bengal, Orissa, Tavoy, and Tenasserim. 3,000-12,000 feet. (4, 21)
- **28. *Rana sternosignata* Murray
Kashmir, Baluchistan, and Sind. Elevation (?) (9)

29. *Rana gammiei* Annandale
Sikkim and Darjeeling. 3,000-6,000 feet. (9, 21, 22)
30. *Rana assamensis* Sclater
Sikkim, Darjeeling, and Khasi Hills. 3,000-6,000 feet. (9, 21, 22)
31. *Rana monticola* Boulenger
Sikkim, Darjeeling, and Nepal. 3,000-6,000 feet. (9, 21, 22)
- *32. *Rana gerbillus* Annandale
Sikkim, Pashok (Darjeeling), and Abor foot-hills. 0-6,000 feet.
(9, 21, 22)
33. *Rana latopalmata* Boulenger
E. Himalayas, Khasi Hills, S. Yunnan, Burma, South to Tenasserim.
1,000-6,000 feet. (9)
- *34. *Rana breviceps* Schneider
Sikkim, Darjeeling, Nepal, W. Himalayas, plains of India, Khasi Hills,
and N. Burma. Plains to 9,000 feet. (21, 22)
35. *Rana swani* Myers and Leviton
E. Nepal at 1,500 feet. (22)
36. *Rana polunini* Smith
Sikkim, Darjeeling, and Nepal. At 11,000 feet. (22)
37. *Staurois afghanus* Gunther
Sikkim, Darjeeling, Nepal, Khasi Hills, Assam and Burma. 0-6,000 feet.
(4, 21, 22)
38. *Staurois himalayana* (Boulenger)
Sikkim and Darjeeling. 6,000-9,000 feet. (1, 9, 21, 22)
- *39. *Staurois formosa* (Gunther)
E. and W. Himalayas and Khasi Hills. 3,000-9,000 feet. (21)

Family Rhacophoridae

40. *Phrynoderma moloch* Annandale
E. Himalayas. 0-3,000 feet. (21)
41. *Philautus andersoni* (Ahl)
E. Himalayas and N. Burma. 0-6,000 feet. (21)
42. *Philautus annandalii* Boulenger
Sikkim and Darjeeling. 3,000-6,000 feet. (4, 13, 21, 22)

43. *Philautus argus* (Annandale)
E. Himalayas. 03-,000 feet. (21)
44. *Philautus dubius* (Boulenger)
Sikkim and Darjeeling. 6,000-9,000 feet. (21, 22)
45. *Philautus simus* Annandale
E. Himalayas. 0-3,000 feet. (21)
46. *Rhacophorus jerdonii* (Günther)
Sikkim and Darjeeling. 6,000-9,000 feet. (21, 22)
47. *Rhacophorus microdiscus* Annandale
E. Himalayas. 0-3,000 feet. (21)
48. *Rhacophorus leucomystax* Gravenh
Sikkim, Darjeeling, Khasi Hills, N. and Lower Burma, Thailand,
Yunnan, S. China, Szechuan-Sikang, Hong Kong, Formosa, Java, Borneo,
Celebes, and the Philippines. 0-12,000 feet. (12, 21, 22)
- *49. *Rhacophorus maculatus* Günther
Sikkim, Darjeeling, Nepal, W. Himalayas, plains of India, Assam, N. and
Lower Burma, and W. China. Plains to 3,000 feet. (4, 21, 22)
50. *Rhacophorus himalayensis* Annandale
E. Himalayas. 0-3,000 feet. (21)
51. *Rhacophorus naso* Annandale
E. Himalayas. 0-3,000 feet. (21)
52. *Rhacophorus bimaculatus* Boulenger
E. Himalayas, Khasi and Karim Hills, Lantao Hill, and Malay Peninsula.
Elevation (?). (12)
53. *Rhacophorus maximus* Günther
Sikkim, Darjeeling, Nepal, Khasi Hills, Assam, and N. Burma.
0-6,000 feet. (21, 22)

(To be continued)

Sea Turtles in Indian Waters

Seaturtle Investigation: S. VALLIAPPAN ASSISTED BY SOLOMON PUSHPARAJ.

Tuticorin, 12th—17th June, 1973. Sponsored by Madras Snake Park Trust, Madras—22

Introduction :

Upon inquiring we found that there are no existing laws protecting the five genera of seaturtles and their eggs in India and no control on the exploitation of these endangered animals. Although it is not a major export industry the present pressure on these international animals is too great to allow their continued survival. In order to provide a sample of what the seaturtle industry is in India we deputed two members of the Madras Snake Park Trust staff for a one week investigation in Tuticorin, a centre for the turtle industry in India (South). The following is their report :

Sea turtles found around Tuticorin (in order of abundance)

English name	Scientific name	Tamil name	Translation
1. Green sea turtle— <i>Chelonia mydas</i>		a) Paeraamai b) Thaenaamai	Big turtle Honey turtle
2. Hawksbill — <i>Eretmochelys imbricata</i>		Nanjaamai	Poisonous turtle
3. Loggerhead — <i>Caretta caretta</i>		a) Panguni b) Perunthalaiyan	Big headed turtle, a Tamil month, (Mar. 14th April, 14th) when they are most common
4. Ridley's <i>Lepidochelys olivacea</i>		Paingiliaamai	Beautiful parrot turtle.
5. Leatherbacks — <i>Dermochelys coriacea</i>		a) Ongal b) Aezhu vari aamai	'which has grown huge' Seven lined turtle

People interviewed: Local fishermen, fish exporters, State and Central Fisheries Departments, fish market people, fishing trawlers, local public, harbour people.

A. General notes :

The fishermen (even their kids) are very fast at naming sea turtles from pictures. According to them 90% of the turtles caught are the Green sea turtle. They associate the

presence of turtles throughout the year with the abundance of food in the waters around the coral reefs near this coast. There is a chain of about 20 small islands and atolls extending 160 km. along the coast from Tuticorin to Rameswaram, 5-6 km. off shore. The average water depth is 2 fathoms between shore and islands and 3 fathoms in channels between the islands. According to the fishermen this is ideal depth for sea turtle feeding and mating. The fishermen know the reefs very well and are careful not to smash their boats. They call the reef 'Paarai' which means rocks. They say the habit of the sea turtle is to use the high tide to get over the reefs to find feeding places and come back with the receding tide. By this time the fishermen have placed their heavy large holed nets of a bottom set type (Paaichchuvalai) across the channels between islands and reef or parallel to the reefs. The normal tide variation is 1.4 metres; the bottom between mainland and islands is mostly muddy. The fishermen believe that the turtles feeding in this area go to the islands with the least human interference for nesting because they don't see much egg-laying. Others feel that though they feed in this area the turtles go elsewhere, probably along northern beaches, to nest. There is very little sale of eggs in this area. The fishermen note very little seasonal variation in numbers, sea turtles are always around. They say that the stretch of beach between Tiruchendur and Indinthakarai is a turtle nesting area and they believe that Ridley's sea turtle come in great numbers to lay eggs there. They mention that "a Ridley found will be a female full of eggs". They believe that Ridleys come ashore a few days before actually laying and digs a few test holes. Some years ago great numbers of nests could be seen along beaches near Manappad; it is also said that the beaches of Ceylon, Laccadives and Minicoy islands are well known nesting areas.

The fishermen call the 'turtle grass' on which the Green Sea turtle feeds "kadal paasi", they also note that barnacles are found on turtles that feed at one place for a long time. We removed barnacles from the sides of the head, mid-plastron and mid-carapace, but only a few turtles had them.

With reference to the Hawksbill turtle its meat is sometimes poisonous, perhaps because of some seasonal change in feeding habits. Some fishermen say 2-3 Hawksbill in every hundred are poisonous throughout the year. In 1972 about 20 persons died in Thazai village from Hawksbill meat poisoning. Experienced turtle catchers are able to identify poisonous meat. There are three maintests:

Not poisonous

1. Blood drips off knife blade quickly.
2. A drop of blood on the skin does not itch.
3. When the meat is washed with a bit of lime added it does not change colour.

Poisonous

1. Blood thickens on knife blade.
2. A drop of blood on skin itches and the spot becomes inflamed.
3. The addition of lime changes the meat to a green colour.

The symptoms of Hawksbill poisoning are swollen lips, vomiting, "cleft tongue" in 2-3 hours after consuming the meat. Some fishermen maintain that the best months for turtles are July-September which corresponds with the highest tides, June, July and August. They observe that when Green Turtles are mating nothing bothers them and they can be easily hauled out. They are said to lay eggs 4-5 times a year. There is some association with cobras which also carefully choose a place to lay their eggs. Most fishermen have not seen baby turtles, but only yearlings.

The previously mentioned islands along this coast are of a rigid calcareous framework, covered with sand. The vegetation is thorny scrub with hares, saw-scaled vipers, sand boas, bearded lizards, larks, wading birds and crabs being the main flora and fauna. Except for Krusadi Tivu all the islands are uninhabited but their waters are frequented by small fishing boats. Hare Island (now no longer an Island but attached to the mainland to form the Tuticorin Harbour Project) was once the site of much sea turtle activity but which has ceased because of all the underwater blasting and construction. This is a well-known pearl fishing area which is carried out for one season every two years. The other islands in the chain are said to be very similar to Hare Island, most of them average 3-6 kms in size. Beach temperatures we recorded were high; 48°C Low 30°C.

B. The Market at Tuticorin

Every Sunday morning between 6 and 8 a.m. 20-30 sea turtles (mostly Green Sea) are slaughtered at the Tuticorin fish market. These are all animals caught either by chance or by those fishermen who specialize in turtle catching. They are kept in pens (20" by 20") in a marshy area (water 3'-4') at Roche Park near town or sent by rail from near by coastal towns, addresses inked directly on the plastron. About ten years ago there was a big export market to Ceylon (evidently for re-export). Since then Ceylon stopped sea turtle import and more recently put a total ban on sea turtle killing. After sometime West Germany and the U.S.A. were the main countries buying the frozen meat shipped in ship's reefers. At that time the dealers would buy large numbers of turtles from the fishermen and the take was about 4000 per year (at present it is 1500, mostly local use). Some dealers even constructed big holding tanks 40' by 40' for storing live turtles. At present there is little export market but the dealers and fishermen, based on their correspondence with Japanese and American dealers feel that the business will boom again for them.

So far the trading has been irregular but once the regular ships start arriving with the nearly finished Tuticorin Harbour Project the business will also become regular they say. They say they still have good contacts in U.S.A., Japan, W. Germany and Europe. Japan seems most interested in the shells, possibly both for the outer shell for polished

artifacts as well as for the calipee, (the high-priced cartilage in the lower shell used for soup making).

Anyway, on Sunday morning there is a long 'Q' for turtle meat and one by one the animals have their throats out by a boy who also carries a cup to collect the blood. Blood is carefully collected and a 250 ml. glass costs 1 rupee and drunk on the spot like an elixir. An average green turtle gives 10 to 12 glasses of blood and that from the lungs, heart, liver is considered particularly good in curing certain consumptive diseases. The meat is sold at Rs. 4 per kg. and an average turtle yields 40 to 50 kg. The shell can be sold for Rs. 50 so the average turtle on the market is worth Rs. 250 or more. It is purchased from the fishermen at the rate of:

Rs. 10-15 for sizes 45 to 55 cm. length.

Rs. 25-30 for sizes 60 to 70 cm. length.

Rs. 45-60 for sizes 90 to 100 cm. length.

Rs. 65-75 for sizes over 115 cm.

The 90-100 cm. length Green Sea turtles are most common weighing 50-60 kilos, roughly 70% are females, 20% males and 10% young. The head, flippers, liver, fat, meat and guts are all eaten. People prefer the medium sized turtles, saying that young turtle meat is too lean and big turtles too coarse. The shells of Green turtles are sold at Rs. 20 per kg. and the plastron (lower shell) at Rs. 40 per kg. Hawksbill shell sells for Rs. 100 to 150 a kg. and exported mainly to Japan. Leatherback carapace is cut into small pieces and boiled to prepare an oil to paint boats against leaks. There is no local demand for shells, but some dealers store them for possible foreign orders.

Conclusion Notes :

It has been observed by various Snake Park associates and correspondents that besides Tuticorin many other coastal and island towns have a sea turtle industry. These include coastal Orissa, Bengal and Kerala, the Andamans, Maldivé and Minicoy Islands. In addition it may be assumed that wherever there is a fisherman population sea turtle eggs are harvested. In Madras in December and January large quantities are sold by door to door vendors for up to 15 paise each or at 5 paise each wholesale from the fishermen. The taste for the meat is restricted to certain religions and castes, for example in Tuticorin it is only the Catholic Christians who go in for turtle meat.

It is imperative that we accept the findings of the I.U.C.N. on the endangered position of the world's sea turtles, and urge our legislators into protective action. Simultaneously we hope to work on public opinion and developing interest in the habits and ecology of the marine turtles to help their position. All sea turtles should be placed on Schedule 1 of the Wild Animal Protection Act, 1972 giving them complete protection. Since they do offer a valuable source of protein eventually they can be carefully exploited.

In their present depleted state however it is only logical that we afford them full protection while studies are being made and population surveys are made in different parts of the world.

The Madras Snake Park will continue its research into sea turtles as part of our general interest in reptiles and especially in seeking recognition and protection of the commercially exploitable species. Total protection of the sea turtles will only be a minor inconvenience to a very few people and of great potential benefit in the long run.

Blackbuck and *Desmostachya bipinnata* (L.) Stapf

By

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For the last several years, the authors have been observing in the 'preserve' owned by the Maharaja Fatehsingh Zoo Trust at Dhaniavi Bid (Sunderpura), 11 km. from the city, occupying 287 acres (116 ha) and protecting about 350 Blackbuck, a tufted grass—*Desmostachya bipinnata*. Locally known as *Dabh* or *Darbh*, it is used in Hindu ceremonies and is of medicinal value.

On the palatability of this species, Bor (1960, 491) writes: "..... Opinions about the value of this species as a fodder vary, but it certainly is considered to be of great value in Afghanistan, possibly because in such an arid country fodder of any kind, no matter how unpalatable, enables stock to survive. According to Duthie it is chopped, mixed with grain and wheat, and fed to stock....."

The tall, leafy, perennial grass which is fairly abundant and at times forms a dominant feature of the deciduous forest vegetation in the area under observation, does not seem to be interesting as fodder; apparently unpalatable, the spiral-horned Blackbuck leave it alone when feeding, but nevertheless uses it for shelter—especially to conceal the young fawns from pariah dogs and jackals which are its principal enemies in the 'preserve'.

In India, the Blackbuck is locally extinct in many places. The authors, therefore, suggest that *Desmostachya bipinnata* which has a wide range of distribution throughout India, though not pleasant to the taste of fleet-footed, beautiful member of the Indian Fauna, should not be wiped out completely from any of its habitats for it ultimately goes a long way to save the Blackbuck from extinction as it affords protection to the newly born fawns.

The species was sent by the senior author to Dr. N.L. Bor, F.L.S., of the Royal Botanic Gardens, KEW, with a view to establishing the identity. Mr. J.P.M. Brenan,

F.L.S., of KEW, in his letter of 12th January 1970 writes: "..... The specimen of grass sent by you is indeed *Desmostachya bipinnata* (L.) Stapf as you surmise"

The authors are grateful to KEW authorities and owe sincere thanks to the Maharaja Fatehsingh Zoo Trust for facilities received during the field work.

Reference

Bor, N.L. (1960). *The Grasses of Burma, Ceylon, India, and Pakistan (excluding Bambuseae)*, London.

For the last several years, the authors have been observing in the preserve owned by the Maharaja Fatehsingh Zoo Trust at Dhankot (Bundelkhand), 11 km. from the city, occupying 287 acres (116 ha) and producing about 250 blackbuck a tailed grass—*Desmostachya bipinnata*. Locally known as Dabhi it is used in Bundelkhand and is of medicinal value.

On the probability of this species, Bor (1960, 1961) writes: "..... Opinions about the value of this species as a fodder vary, but it certainly is considered to be of great value in Bundelkhand, possibly because in such an arid country fodder of any kind, no matter how unpalatable, enables stock to survive. According to Dabhi it is chopped, mixed with grain and water and fed to stock....."

The tall, leafy perennial grass which is fairly abundant and at times forms a dominant feature of the deciduous forest vegetation in the area under observation does not seem to be interesting as fodder, apparently unpalatable, the spotted-necked blackbuck leaves it alone when feeding, but nevertheless uses it for shelter—especially to conceal the young fawns from peep dogs and jackals which are its principal enemies in the preserve.

In India, the blackbuck is locally extinct in many places. The authors, therefore, suggest that *Desmostachya bipinnata* which has a wide range of distribution throughout India, though not pleasant to the taste of spotted-necked blackbuck, is ultimately necessary should not be wiped out completely from any of its habitats for it is indispensable as a safe way to save the blackbuck from extinction as it is not protected in the nearby forest.

The species was sent by the senior author to Dr. N.L. Bor, F.L.S., of the Royal Botanic Gardens, Kew, with a view to confirming the identity. Mr. J.P. Sengupta

Foul Murder of Our Wild Animals

Stop It Now, Or ----

By

FEROZE GHEYARA

The problem of India's fast vanishing wild life is to-day an subject of gloomy concern for Conservationists and Wild Life lovers, the world over.

Wild animals in their natural habitat require only a few favourable factors for flourishing, like water, food and shelter. They do not ask for any favours from man except that of being left alone. And yet so heavy is the depredation that man has inflicted on them in recent years that even the once common and abundant species, such as the black buck and the chinkara, which formed a living part of the country's landscape, survive only in a few isolated pockets, where religious sentiment alone affords them protection. By and large, the sights and sounds to which the jungles echoed are now stilled.

From amongst the species immediately threatened with extinction, the one that draws universal attention is the Tiger, the most magnificent animal in the world. An animal of dramatic beauty, of rippling muscles and hypnotic gaze.

If we are convinced of the necessity of devising ways and means to revive our dwindling fauna then we must first have a clear understanding of the factors which led to the decimation of wild life, starting from a period not too far back, when game was fairly abundant.

As one who has nearly 30 years of field experience of the Indian jungles and has found more happiness in the loneliness of the jungles than in the hustle of big towns and cities of India, I am giving what is to my mind a dispassionate and objective analysis of the situation and it is likely that the opinions expressed by me may not pander to popular beliefs and sentiments.

The Forest Department had then devised a fairly comprehensive set of rules governing hunting and shooting aimed at the preservation and perpetuation of game. These included the entire closure of shooting blocks for the four monsoon months, and the total closure if the year's quota of two or three tigers were shot in the opening months. The idea was to crop only the surplus population of game every year.

After independence, our emphasis was more on preservation than shooting. The then State of Bombay took the lead and came out in 1953 with the Wild Animals and Wild Birds Protection Act of 1951. This law ended some lacunae in the previous relevant Act and prescribed stringent penalties for illegal shooting.

Other States also made their own legislation in course of time. The Central institution, the Indian Board of Wild Life, was constituted in 1952. But it was not invested with enough authority and its suggestions were only of a recommendatory nature. The result: no uniform legislation for all the States.

Immediately after independence, the crying need was to augment food for the people. In villages in and near jungles, wild animals like elephants, buffaloes, sambhar, cheetal and pigs caused damage in varying degrees. Elephants destroy more than they eat and a herd can, in a single night, bring to naught a whole family's labour of many months and wipe out their entire food supply for the ensuing year.

The villager's usual stratagem of beating empty tin cans did not always work out. So the District Magistrates were instructed by State Governments to liberally issue licences for what was designated as 'crop-protection guns'.

The State Governments could not have foreseen the havoc it was to play on the fauna. Although it was a condition that the gun was to be used within the precincts of the fields only, gradually crop protection guns were misused to pursue animals in their haunts.

During the hot months, the only source of water for the animals are a few small pools interspersed in forests. This is where the crop protection guns take their heaviest toll. The *modus operandi* of these shikaries is to select water-holes which animals frequent and erect nearby a ground or a tree 'machan' a few days ahead to allow the animals, who come to drink, to get used to this new construction.

These guns shot just about anything on four feet: not only old males but young and immature males, immature females, mature females and even those heavy with young. The laws have always forbidden the shooting of females for the obvious reason that a male shot is one animal less in the herd, but a female shot would mean a loss in geometrical ratio. A female gives birth to one or two fawns every year. When the shooting of the females starts on any large scale, it means the extinction of the species.

These activities are not unknown to the local ranger or forester and his acquiescence is usually purchased by suitable bribes.

One of my favourite jungles—not far from Bombay—has around 300 villages and an over-all area of 1,700 sq. Km. Out of this the reserved and protected forests measure about 1,100 sq. Km. Before independence the total number of guns in the villages here was about twelve.

Now there are 1,014 crop-protection guns and 250 self protection guns, which are misused for obtaining meat. This comes to over 1,250 guns in an area of 1,100 sq. Km., a little over one gun per sq. Km. What chances have the helpless animals for survival? And this situation prevails practically everywhere.

In addition to this, most villagers have illicit guns. In Madhya Pradesh the local 'chikhlighars' make a passable hammer gun, the barrel of which is made out of conduit pipes. Apart from the actual killing from these guns, they exercise another deleterious effect on the jungle animals. The constant firing in the hot wheather on water holes at night, which is the period of their foraging activity, makes the animal nervous, their robust physical state deteriorates with tension and, in this condition, they are disinclined to mate.

Devilish Methods

Villagers also employ many other devilish methods, totally insensitive in their cruelty. Netting of animals, spiked pits, cleverly concealed nooses, steel-hooks attached to wires hidden in fruits which anchor the animals by the tongue or side of the cheek, bombs covered with flour paste placed in the fields so then when an animals bites on it, its mouth is blown off in a ghastly fashion, are becoming all too common.

I say it emphatically that this is the hard core of the damage to wild life and the surreptitious carnage that people cannot see and therefore are not aware of but if you cannot stop this cogent cause of distruction which strikes at the very roots of the animal's existence, then all your fancy legislation and even putting into practise all my suggestions, some practical, some ambitious, have no meaning whatever.

In public imagination, the true or legitimate license-holding sportman has today come to be mixed with the category of poachers. This is an errant misconception. The true shikari is not responsible for the present annihilation of wild life. On the contrary, his presence in the forests exerts a deterrent influence on the poachers. Many of our schemes of Wild Life Preservation have emanated from these true sportmen.

The pelts of tiger and panther fetch a handsome price. Therefore, the villagers now internally smear liberal doses of Follidol (rat poison) into the carcasses of animals killed by carnivorae. Result: a dead tiger or panther without firing a shot and a precious pelt in the bargain.

Then there is the 'Chamar' tribe, who on hearing the death throes of animal at the fangs of the carnivorae, will rush boldly in a large body to the spot at night with burning torches, and drive the carnivorae off its 'kill' to appropriate the meat for themselves, thus compelling the tiger and the panther to kill more and more often to keep themselves in food.

It is amply clear that the over-whelming destruction of the fauna of our jungles originated from within the jungles themselves and I feel surprised that the conservationist so far have failed to take sufficient note of and appreciate this simple fact.

Another destructive factor is the urban poacher with his jeep, spotlight and a modern rifle, who shoots indiscriminately for commercial gains or just for the 'heck of it'. His method of hunting is hit and run affair and he usually leaves behind him a trail of wounded animals. The village poacher can at least put forward a plea of ignorance and lack of education but the urban poacher can hardly have such alibis and he must be dealt with strictly without any mercy.

Then, though not in the same class as above, comes the licensed shikari, who under the cloak of his licence and often in league with minor forest officials, shoots prohibited species or females, sometimes in excess of his quota.

The other factors which contribute to the decimation of our wild life are increase of human population and need for arable land; the jungle villager's natural desire for meat; destruction of natural habitats by erection of hydro-electric projects and water-works etc., and domestic cattle being driven into forbidden territory to consume the fodder reserved for jungle animals.

The indiscriminate planting in large areas of eucalyptus and other trees solely for forest revenue which yield neither shelter nor fruit for the animals, and illicit cutting of trees and denudation of scrub jungles depriving animals of food and shelter, also play their inglorious role.

Over the years, so deeply has been entrenched this pernicious habit of poaching amongst village and urban poachers as to have now become a way of life and attempts at reversing these trends would amount to having to clean the Augean Stables. Efforts to cut down on the numbers and bring under control the crop-protection and self protection guns may even cause a political rumpus. But then the alternative is to throw up the sponge, allow the present state of affairs to continue and see the extinction of some of the most precious species during our own lifetime.

The remedial measures must be drastic. But we must remember that many of these are already part of the laws governing the issue of gun licences and hunting and shooting.

Law Is Not Enforced

Stringency is lacking in the enforcement of these laws. All the protection needed by wild animals has already been brought under the purview of law and incorporated in the form of rules and regulations. But a good law is only as good as its enforcement agency and, where the enforcement agency has been lax, the law is dead. At present, the forest official, who is entrusted with the additional burden of Wild Life Preservation in many States, is usually over-worked. His job is to extract the maximum revenue from the forests and he has neither the time nor the inclination to be bothered about the fortunes of wild life.

As such, the first imperative measure in each State is the creation of a separate Wild Life Preservation Department, consisting of adequately trained staff dedicated to natural conservation and preferably vegetarians. Of course, the first question would be of finance but the Central Government can subsidise the States to seventy-five per cent of their expenditure on the creation of this new Department. In course of time, the Centre and the States can recoup all they have spent through the increase in the tourist traffic. Wildlife is a major tourist attraction the world over and our fauna is not inferior to African wildlife.

As regards this separate Wild Life Preservation Department, the set-up should be on the style of the Uttar Pradesh Department, where even the beat guard is given a cycle and a .12 bore gun for self-defence and the authority to go along with the licensed shikari whenever and wherever he is going. The Assistant Game Wardens are provided with a motor-bike and a gun, and the Game Wardens with a jeep and armed forest personnel. At the top, the Chief Game Warden is provided with a jeep station wagon and armed police guards.

The powers to issue crop-protection and self-protection guns should be totally transferred to this new department as they, being on the spot, would be in the best position to assess the validity of the applications.

Withdraw The Guns

And all crop-protection guns should be withdrawn into police custody around January or February when there are no standing crops in the fields and re-issued in mid-July during the rains.

The guns issued for self-protection should have their action sealed. In case of breakage of the seal, the onus should be on the owner to prove the genuineness of the incident.

For the animals, artificial pools of water with cement bottoms to prevent seepage and an oily film on the top to reduce evaporation, should be dug at various places to overcome shortage of water in the hot weather. The Department should constantly check these pools during the hot weather to nab poachers.

Spotlights must be banned in the jungles. Uttar Pradesh does not even allow torch-lights taking more than two cells.

Courts should be persuaded to take a grave view of offences and award deterrent punishment. Finally an appreciation of the importance of our wildlife should be inculcated among children at the school level.

If we do not stop the killing now, there will be nothing left of our wildlife heritage but the trophies and the talk.

Gharials (*Gavialis gangeticus*) and Marsh Crocodiles (*Crocodilus palustris*)

By

S.P. SHAHI, I.F.S.,

Chief Conservator of Forests, Bihar.

Two species of reptiles of the Order Crocodilia that are found in Bihar, are the Marsh Crocodiles (*Crocodilus palustris*) popularly called the *Mugger* and the Gavial (*Gavialis gangeticus*), commonly known as "Gharial". There is yet another variety of salt water crocodile (*Crocodilus porosus*) confined to the coastal regions of West Bengal and Orissa.

Gharials live in big rivers with good deal of current like the Ganges, Brahmaputra, Indus, Mahanadi, Kosi and Gandak. The marsh crocodiles, on the other hand, is primarily an inhabitant of stagnant water of marshy *Jhils*, reservoirs and rivers with less current. One is often misnamed for the other.

Gharial's long snout has beak-shaped jaws, with a lump on the extremity of the nose and he attains a length of 20 feet and more. James Inglis (1890) in his book "Adventure in Tiger Land" speaking of Gharial wrote "Going down the river Kosi particularly, you come across hundreds sometimes lying on one bank".

A Gharial Survey was conducted by the Zoological Survey of India in 1968. People of Madhepura in the Saharsa district reported during this survey that 10 or 15 years back a lot of Gharials used to come to Madhepura town with the flood water of Kosi in the rainy season. The survey reports that as the Kosi is now trained by the embankments on either side, the species gets restricted area to live in and this may be one of the causes of its decline in population. A large number of Gharials have been shot indiscriminately for the value of their skins and there is no doubt that this has been a great contributory cause in the rapid depletion of its number. Confined within five miles of the embankments, when the headwater supply of Kosi river decreases after the rains, the Gharials come out at day time on the exposed sand beds in colonies of 2 to 8. Earlier they could be seen in hundreds when the river was untamed. In this small width of 5 miles they have now become more vulnerable to human predation. In the report of the zoological survey quite a few instances of their recent killings have been cited.

I happened to see and photograph a Gharial in November, 1972 in the Gandak river—some 6 miles down the Gandak barrage. The Narayani originating from the Central mountainous basin of Nepal enters Indian territory at Triveni where it joins the Panchnad and the Sonha to form the Gandak, not far from the Gandak Barrage. With the background of snow-clad Annapurna range of hills of the outer Himalayas, the confluence

surrounded on all sides by well wooded hills, is very picturesque sight in the clear winter sky immediately after the monsoon.

It appears the Gharials from Narayani flow with the swift current to Gandak in the rains. This animal had been basking in the sun on one of the sand deposits since the previous day and when I saw him, he used to slide noiselessly and slowly into the stream whenever a fishing boat passed near him but would appear again as the boat moved away. At some three hundred feet from the bank he looked as if he was about twenty feet long. His massive muscular tail was clearly visible.

Gharials live upon fish and do not attack men or animals, although an instance is reported of a paddy bird (Egret) which while darting out his long bill to catch fish was suddenly caught by a Gharial in his long snout and crunched up.

In this respect a marsh crocodile (Mugger) is far more dangerous. He has often been found lurking on the banks of lakes or ponds to catch human beings. Several instances of helpless women and children near bathing ghats or ferries being devoured by Mugger are known both in India and in Africa. On being shot and cut up, ornaments of brass, silver and gold have been found in his stomach. Brander gives a list of animals he has taken out of Muggers shot by him: men, leopards, wild dogs, hyenas, cheetal, the young sambhar and nilgai, barking deer, monkeys, domestic dogs, pigs, ducks and a large variety of birds.

A crocodile's tail is his very powerful weapon. With one swing of this appendage he can even upset a boat. In swimming he propels himself with the tail and few animals can match his speed travelling under water. He can approach an animal drinking water without making the slightest ripple and with his tails sweep the unsuspecting animal off his feet into water and devour him.

Reptiles have evolved from amphibians that dominated the swamps for almost 100 million years. A wide variety of these amphibians existed then but they all died away leaving only a few, some common surviving ones being the frogs and toads.

Over 50 million years after the amphibians appeared, a new creature evolved from them. While amphibians always laid their eggs in water, this new creature laid eggs on land and breathed through his lungs; this was the first true land animal—the Reptile.

For 120 million years the reptiles were supreme. The best known—the dinosaurs—were in some cases 65' long and weighed as much as 30 tonnes. These creatures needed several hundred pounds of vegetable food a day to support their gigantic bodies and when the climate of the earth changed and the lakes and marshes dried up; they died too. To-day only 5 groups of reptiles remain including the common lizards, snakes, turtles and the crocodilians.

Crocodiles (Gharials, Mugger, etc.) have been known to live for 50 years or more and fossils have been dug up which show that as a species the crocodile has scarcely

changed for a hundred and eighty million years and that he is now the nearest living link with his extinct relative—the dinosaur.

The crocodiles are cold blooded animals and their bodies are no warmer than surrounding air. It would therefore be useless for the parents to sit on the eggs. The eggs are therefore covered on the sand beds by the mother to secure the necessary warmth.

The youngsters are born with all the instincts to swim, dive and bite their prey at once. A remarkable thing about Gharial and Mugger, in fact all crocodiles; is that despite his wonderful teeth, he is completely unable to chew his food. Instead he has to swallow each mouthful whole. The reason for this is that whenever a crocodile opens his jaws under water to catch a fish, a special valve at the back of his mouth closes tight to prevent the water running down into his stomach. For the valve to open and let his swallow, the crocodile has to lift his head right out of the water and allow the food to slide straight down his throat.

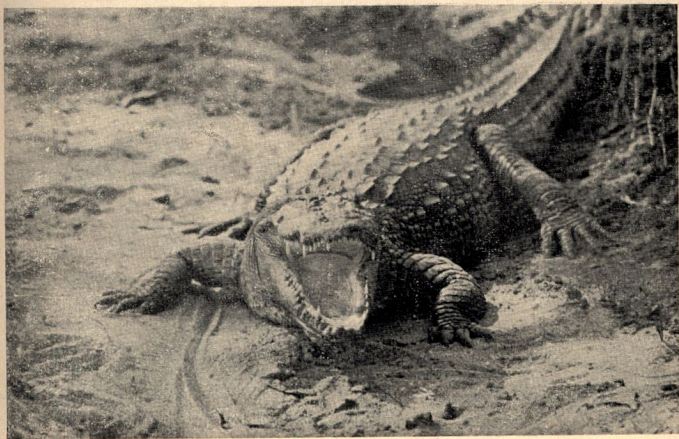
In some Shikar books, crocodiles are often referred to as Allegators. The fact is that while allegators are one of the 21 living species of crocodilians known to exist in the world, they are a separate family by themselves. The strangest thing about allegators is that they are found in just two places in the world: in the Southern United States and along the Yangtze River Valley in China. Why these creatures survive in only two such widely separated places is still a riddle.

Though the Gharials are found in the Ganges and Gandak, their main haunt continues to be the channel of the Kosi in between the two embankments. They have been seen near Kursela, Dhamarghat, Namua, Nauhatta and Mahesi in the Kosi area.

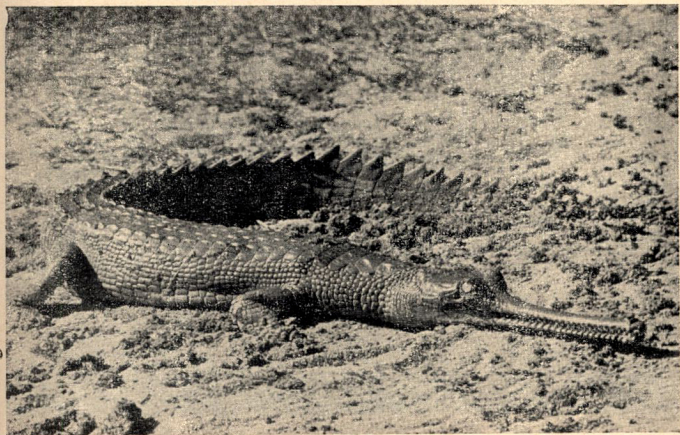
The distribution of marsh crocodiles is however, much wider and they still exist though in depleted numbers in the pools of a number of rivers and rivulets flowing through the forests such as the Koena (Singhbhum), Karmanasa (Rohtas) and in the Horio-Khad pool in Mohane river (Hazaribagh). At Horiokhad the Mohane river debouches into the plains with a drop of several hundred feet forming a pool of some five acres of water. Nearly half a dozen crocodiles have been seen in this pool. This picturesque pool is undisturbed from biotic influences. Cattle cannot recach this place.

Karmanasa river near Karkatgarh in Bhabhua sub-division of Rohtas district is another ideal place where crocodiles have been known to exist since a long time but fishing right in Karmanasa river has taken a heavy toll.

I have also seen a Marsh Crocodile near Ormanjhi in Ranchi district in the Bhenra river pool. The villagers however, extensively use the pool for fishing. Being near Ranchi, the place has a good potential for a crocodile sanctuary for tourists.



Marsh Crocodile (*Crocodylus palustris*)



Gharial (*Gavialis gangeticus*)



The Sunday morning lineup of live sea-turtles, soon to be meat. (See Page 26)

Photo: S. Valliappan



Fig. 2. Blackbuck (*Antelope cervicapra*) in the Baroda 'preserve'. (See Page 31)

The position of both these two species of Crocodiles in the whole country is so precarious that a ban on the export of their skins has been imposed by the Central Government. Also the crocodiles have been categorised in Schedule I of the Wild Life (Protection) Act, 1972 along with Tiger and Black Buck, who too are threatened with extinction. Shooting of these animals in any part of the country is prohibited by law. There is, however, no suitable implementing machinery to implement it: with the result that crocodiles continue to be poached. Their survival is now a matter of deep concern.

While affording adequate protection to the remnant population of these two species, a very significant contribution to their rehabilitation in their existing haunts can be made by captive breeding programmes.

Crocodiles lay a large number of eggs but due to natural hazards and predators, few of the young ones are able to reach maturity. Marabou Storks gobble up a large number of baby crocodiles as soon as they are hatched and the Monitor lizards break open the shells and eat the yolk even before the eggs are hatched in Africa. Such predation in well protected sanctuaries are desirable. They help in maintaining a balance between different animals. If all the eggs are hatched and grow into mature crocodile, there would be far too many of them in a given locality.

While no study of crocodile predation in India has been made but judging from the fact that the population of crocodile is going down an important contributory factor could be the destruction of the eggs and hatchlings by animal predators. Under captive conditions however, the whole clutch of the eggs can be reared with insignificant losses and released subsequently in selected rivers and pools.

Captive breeding of crocodiles has also proved to be a commercially sound proposition. A crocodile Farm located near the Gulf of Thailand, not far from Bangkok rears some ten thousand crocodiles of different age groups. Besides being commercially sound, it has turned out to be a great tourist attraction too. Some of our pools could be developed on similar lines.

It will be unfortunate if the Gharial which at one time had a world wide distribution and the marsh crocodile vanish from the State for want of adequate measures to protect and rehabilitate them. Gharial is the oldest representative of the Order Crocodilia and is the only species of the family Gavialidae still surviving in the country.

Multipurpose Dams And Fisheries

By

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Introduction

India is proud of having a large number of important rivers with millions of cuses of water running through them to the sea. As a development measure, it was considered necessary to utilise, the vast resources of water for multipurpose use such as irrigation and hydro-electric generation of power. In doing so, some of the most furious rivers could be kept under control and their fury harnessed for better use. River water is one of the important natural resources which could be put to best use in a country of limited means, as India. People in many parts of this land suffer as a result of floods caused by turbulent rivers while in many other parts of this country, there are poorly cultivated, arid and semiarid lands which need better irrigation facilities for production of larger quantities of food grains. Some of the mineral resources, such as petroleum and coal, which are used mainly as fuel, are also limited in this country. Hence, production and increasing use of power was also considered very important in this country.

Fishes constitute an important natural resource for protein food. The importance of fishes from the point of view of food and game, cannot, therefore be over-emphasised. While executing the multipurpose projects and construction of dams across the rivers, the maintenance of the most valuable fish resources of the country has been neglected. The need for the development of fisheries in India has been pointed out by Dr.S.L. Hora, the founder of Ichthyology in India.

By now more than 200 major dams and weirs have been constructed across the rivers in India but very little attention seem to have been paid to the deterioration of the fishery resources of the country. Wherever dams and weirs have been constructed, the important fishery of the area has tremendously deteriorated. Fishery scientists, having deep foresight for the development of the fisheries, conducted pre- and post-impoundment surveys in different parts of India and pointed out repeatedly about the possible harmful effects of the dams and weirs on the commercially important migratory fishes (Khan, 1940; Rai, 1948; Sundaraj, 1941; Devanesan, 1942; Hora, 1940, 1947 a-c, 1948, 1949, 1950; Job *et al.*, 1952, 1955; Job, 1950, 1952; Prashad and Job, 1949).

Mahseer Fishery along Himalaya

Tor tor (Hamilton) and *Tor putitora* (Hamilton), the Mahseers of the Indian waters, are the most important of the commercial as well as game fishes of India, along the foot-hills of

Himalaya. Their importance both from the point of view of food and game is very well known to almost all the game loving and fish eating people of northern India. These fishes are distributed in fast moving streams and rivers in the foot-hills of Himalaya all through its length. *Tor tor*, the red finned Mahseer, grows to nearly a metre in length while *Tor putitor*, the yellow finned Mahseer, attains a size of nearly 2.7 metres. Like many other fishes, they also migrate up and down the river in different seasons of the year. This sort of micromigration among fishes is a well known phenomenon (Tilak, 1971). They migrate for the purpose of reproduction and further continuance of their race. During January-February, May-June and July-Sept., they migrate up the streams to heights ranging between 1000-1500 metres. They deposit their spawn in the quieter sections of the river above and in the tributaries of the large streams and rivers, where their fry finds a calm and safe place to spend their childhood because during young stages they are not fit to face the rigours of the main stream which is rather hazardous. As they grow bigger, they start entering into the main stream and in full grown stages, migrate down stream.

The dams and weirs are usually constructed in hilly sections of the rivers to impound their waters for hydro-electric generation and irrigation purposes. This is exactly the area of the river where these fishes form an important fishery. A dam or weir across the river hinders any upward or downward migration of a fish. If no fish-pass or a ladder is provided at the site of the weir on the dam, these fishes cannot migrate for reproduction and hence the rate of their procreation reduces (Khan, 1940; Hora, 1947 a-c, 48, 49). In a way, the important fishery of the area dwindles. During the course of the last 3-4 decades, the important Mahseer fishery has been tremendously reduced along the foot-hills of Himalaya, rather ruined. This has been amply justified by the pre-impoundment and post-impoundment faunistic surveys of the fishes of the river where dams have been constructed. It is a matter of regret that the important dams and weirs in India lack fish passes or ladders for the migration of fishes. In Punjab, fish ladders were provided at some dams and weirs but majority of them did not function, not because of the design of the ladder but because a continuous flow of water could not be allowed to flow through them all the year round particularly during dry months. Many of them became simply devices to catch big fishes during the course of their movement through the ladder whereas according to the fisheries legislation, fishing of any sort should be prohibited in the river to a distance of at least 500 metres up-stream and the same distance down-stream from the weir or the dam.

The absence of a fish-pass at a dam or a weir is a menace to the continuance of the fishery. In many advanced countries any obstruction of this nature in the bed of a river is considered illegal, unless an adequate provision is made in the structure of the dam for the migration of fishes.

The breeding habit of many commercial fishes have been studied by Khan (1924). The carps and the cat-fishes are the predominant fishes of the fresh water rivers and constitute a

major part of the commercial fishery of the country. The carps such as *Tor putitora* (Hamilton), *Tor tor* (Hamilton), *Labeo dero* (Hamilton), *Labeo dyochilus* (McClelland), *Labeo rohita* (Hamilton), *Cirrhinus mrigala* (Hamilton), *Catla catla* (Hamilton) etc. and catfishes such as *Clupisoma garua* (Hamilton), *Rita rita* (Hamilton), *Mystus seenghala* (sykes) etc. ascend up the rivers during monsoon season in search of suitable breeding grounds. On finding obstruction due to the formation of dams and weirs, these fishes are unable to ascend the river and fail to breed, resulting in considerable reduction in the number of these important species year after year.

A study of the effect of the construction of the weirs at canal head-works on the distribution of *Catla catla* (Hamilton) has been made by Mr. Udai Sing Rai (1948) in Punjab. *Catla catla* was at one time very freely available in natural waters of Punjab. The study indicates that these fishes are now seen in fish cultivating tanks only and hardly any specimen is met with in the rivers above the site of the weirs. This species, like the Mahseer, does not breed in confined waters and hence every time spaw has to be introduced in to the tanks for its cultivation. Because of its big size and deep body, it needs deep water to live in and even at the places where fish ladders are provided at the site of the weirs, the fish hesitate to use them partly because of their design and partly because of the shy and timid nature of the fish. The large tanks and lakes, which still hold this species, act as sanctuaries for this fish; such a situation may not be possible for other carps such as the Mahseer or even the catfishes. Raj (1945) believes that the Mahseer breeds in confined waters in Kumaon lakes but this requires to be tested at other places along the Himalaya.

Fish Versus Food Grains

The engineering authorities concerned with the construction of dams and weirs across the rivers have all along been thinking about the water, dams, power production and irrigation of agricultural land for production of food grains. This aspect is, no doubt, important for a developing country like ours, but if side by side care is taken of another natural resource i. e. fish, at a much smaller cost, compared to large cost of construction of dams etc., a major part of the demand of protein food of the country can be easily met with. In response to the article by Dr. Hora (1947) on the construction of dams and river fisheries, the editors of the Central Board of Irrigation posed an appropriate question "5 Cusecs may be regarded as the minimum discharge through a fish ladder. Will this quantity of water allowed to flow in a river below a dam through a properly designed fish ladder result in the production of fish equivalent in nutrition value to say 10,000 maunds of wheat or more which the same supply of water enables to be grown? If so, it would be in the national interest to divert same supplies of water from agricultural lands to fish lands" (Anon, 1947). On the information supplied by Lt. Col. C.K. Lakshmanan, Director, All India Institute of Hygiene and Public Health, Calcutta, Hora (1948) compared the food

values of fish, wheat and rice weight by weight (Table I). Lt. Col. Lakshmanan was of the opinion that fish protein is superior to that compounds of the cereal protein both in quality and quantity of wheat or rice although other of fish may be slightly poorer. Thus, a comparison of the food value of fish, wheat or rice is rather odd. But as pointed out by Hora (1948), 5 cusecs of water in fish farm can easily produce 1000 lbs. (-453.6 kgs.) of fish annually per acre with considerably less labour and expense than the agricultural farm. India is a country where protein diet is in short supply and fish could provide the most digestible form of high protein. Large scale production can even support some of the small subsidiary industries to utilize fish wastes for the manufacture of fish meal for poultry, isinglass, fish oil etc.

For the convenience of the readers simple and brief definitions of the dams and weirs and fish ladder or pass are given here.

A Weir

It is a dam which runs across the whole width of the river. It is built up of concrete for the purpose of channelising water into canals. Such dams or weirs obstruct the way of upward and downward movement of the fishes. Fish passes or fish ladders are provided at some dams for the purpose of up and down migration of the fishes so that they can reach their spawning or feeding grounds. The weir is provided with a large number of openings or undersluices which are kept closed unless the level of water in the river rises due to rain. Each undersluice is closed by means of an iron gate which is lowered or raised by means of roped pulleys which work with the help of an electrically operated machine. The rush of water through these undersluices, when open, is so tremendous that none of the fishes of the river can ascend. If some fish try, they get horribly injured and die. So the only way to allow fish migration across the weir is to construct fish pass or fish ladder.

Fish Pass Or Fish Ladder

A fish pass or a ladder is a passage which connects the reservoir, with the river down stream and through which fishes can pass up and down. The principle for construction of a fish pass or fish ladder is to retard the movement of water so that a fish has no difficulty in ascending through it (Bayer, 1908).

Types Of Fish Ways

According to Bayer (1908) and Calderwood (1925) there are the following four types of fish ways. They differ in the style of their construction.

(a) *The inclined plane system*:— The path is built of a certain gradient and the checks are arranged in such a way that the flowing water takes a serpentine course. The baffle walls in the passage are provided on alternate sides. The fish, while ascending or descending, also take the zigzag path.

(b) *The pool and fall or step system*:— In this the water level is brought down through a series of short falls and pools alternately so that the water runs down from one step or pool to another through a passage. Each pool breaks the speed of the water. The falls are small and easy for the fish to ascend. This was invented by Mr. Cail, an engineer in New Castle. At the end of each step, the baffle wall contains a hole enough for the fish to pass. The water may overflow above the baffle walls but the fishes ascend through the holes.

(c) *The counter current system*:— The velocity of the flowing water is reduced by meeting it with a current of water from the opposite direction. It was devised by Macdonald (1882).

(d) *Lock and gate system*:— The level of the water is lowered or raised by means of one or more locks operated by gates.

The systems at 'c' and 'd' above are so complicated that they are usually not in use now.

Requirements of a Fish Ladder

The type of a fish ladder is to be decided on the basis of the fish fauna which has to use it but each type of ladder is governed by some common principles which are as follows:

- (1) The water velocity in the fish pass should not be ordinarily more than 3 metres per second. In order to attain this velocity the gradient of the slope in the pass should be at least one in ten which will allow a gentle flow.
- (2) The dimensions of the ladder depends upon the size of the fishes which will use it and the amount of the water available above the weir. As the fishes of small and big sizes have to pass through it, the size of the pass should conform to the size of the larger fishes such as the Mahseer and the large siluroide. During ascent, the fishes should not strike against the walls of the pass and to avoid this the size of each bay of the pass should be at least $3 \times 3 \times 0.5$ metres. The fall of the water in this case will not exceed a height of 20-30 cms.
- (3) The build up of the ladder should be such as to allow sufficient light into the ladder which will impart the passage a natural look so that the fish never hesitates to enter it.
- (4) There should always be a regulated water supply in the ladder irrespective of the season and the construction should be such that the silt is automatically cleared off by the current of the water.
- (5) The base of the ladders should be near a pool on the down current side. The fishes will naturally collect in the pool and finding the mouth of the ladder near about; they will ascend it, if need be. They should be constructed in such a way that it is self advertising (Dunsford, 1911).

A survey of the fish ladders and passes in the dams and weirs constructed in India showed that most of them are ineffective partly because of their design, insufficient water supply during dry months and poaching of large fish from the ladders (Khan, 1949).

Destruction of fish which pass down into the canals is immeasurable (Day, 1873; Thomas, 1888; Dunsford, 1911; Khan, 1940; Rai 1948) because they cannot enter back into the river because of lack of a proper fish ladder and when canals dry up, villagers kill them from small pools. The fish ladders and fish ways, constructed at some dams and weirs do not function properly because their construction was not based on the study of the migratory fishes of the particular area. The fish-ladder and fish-way should cater to the needs of the fishes which have to use them. Apart from the design of the ladders, there are other factors which work against the fisheries such as poaching of fish from ladders which are used as traps and the drying up of the river bed below the ladders because of shortage of water during dry months.

The proposed lines of research on the construction of fish-passes at the dams and weirs are the following:

- (1) The habits of the main kinds of fishes should be studied.
- (2) The capacity and strength of various kinds of fish to ascend through water falls of different strength and velocities, should be ascertained.
- (3) The design of a fish pass should be made on the basis of the studies made at Nos. 1 and 2 above. No. 1 should be studied by a Zoologist, No. 3 by an Engineer and No. 2 by the combined efforts of both.

The type of fish pass has to be suitable according to the type of fish and the river. A single fish pass may not suit all kinds of fishes and different river conditions.

Dams and Fishery Research

Sometime ago it was decided jointly by the ICAR, Central Water Power, Irrigation and Navigation Commission and Central Board of Irrigation that the following research measures in connection with the construction of dams may be taken up.

- (1) In the construction of all dams, assessment of the position of fisheries should be made and measures should be taken for the protection of fisheries.
- (2) Investigation should be undertaken into the bionomics of Indian migratory fishes and the suitable design of fish passes.

Research on this aspect was carried out by a Research Assistant under the guidance of Dr. S.L. Hora (Hora, 1949) and his conclusion coincided with those of Raj (1917) that:

- (i) Construction of fish passes is uneconomical.
- (ii) Fishes collected below the dams may be lifted by some arrangement.
- (iii) Investigations should be undertaken for culture of hill barbels and labeos.
- (iv) Measures should be found to capture and market fishes of the reservoir.
- (v) A fishery scientist should be posted at each dam to look to the fishery aspect in collaboration with Irrigation Engineers.

Suitability of Construction of Dams on the Rivers in Himalaya

Ray (1949) rightly posed a question as to whether the construction of large scale dams in the Himalaya is safe in view of the exceptional instability of this region. It is well known that the Himalaya is geologically comparatively very young and even in the present day it could be in the formative stage. The last uplift of Himalaya that took place somewhere in Pleistocene era could be still continuing in a slow and gradual manner as indicated by a continuous process of land slides in this region. Due to this, heavy amount of silt is carried by the rivers and this could settle behind the large dams. The rate of silting could be so high that any dam would be silted up in the course of 20-25 years and then the real purpose of these dams will gradually get defeated. A span of 20-25 years functioning age of large dams, in view of the money and time spent on their construction, is negligibly small and it is not worthwhile undertaking this venture. Because of the unstable nature of the under-crust of Himalaya, earthquakes are of frequent nature and could pose a serious threat to the security of the dams and of the land and people lying down stream. Although in a developing country like ours construction of multipurpose dams is a major venture towards overall development, still in view of the above mentioned points, our research talent on the engineering side should give due consideration to the above points and seriously review the situation to suggest amendments in the National projects envisaged for future in the Himalaya so as to save the country from a possible natural catastrophe as a result of faulty planning.

Dams Vs. Evolution

The fishes of fast moving streams cannot adapt themselves to the lake conditions created by the construction of a dam. The fishes in hill-streams keep themselves either under the stones or adhering to stones by development of special adhering organs. In a lake, the velocity of water goes to almost zero and the hill-stream fishes cannot live there. Moreover, the fast moving water provides the fishes with great amount of dissolved oxygen which is utterly lacking in standing body of water. Majority of hill-stream fishes feed by rasping off algal encrustation from the stones in shallow fast running streams while many of them search for insect larvae among small stones and pebbles. Both, stones covered with algae and insects among pebbles, would be absent in the deep water of a lake whose base may have only mud. The special organs of these fishes for feeding will be of no avail under lacustrine conditions. Thus, the important commercial fishes such as the Mahseer, labeos, Katli (*Acrossocheilus*) etc. are unable to withstand the tremendous change in their living conditions. If a fish adapts to the new environmental demands, it survives otherwise perishes. Due to the changed conditions of life in these lakes, some of fishes, which would adapt to the conditions, may evolve into newer types. Thus, the original fauna of the river may perish and later a new generation of adaptive forms may populate the lake at a later stage (Hora, 1947 b). The formation of changed ecological niches along the river bed, due to construction of dams could possibly act as a means to the development of newer evolutionary types.

Fish as Wild Life

Earlier, there were no wild life conservation measures attached to dams but recently they have been adopted for fish at the dams and weirs. The fish is now protected in the same manner as any other form of wild life, although the enforcement of laws is such that it fails in its real purpose. Large scale poaching of fish goes on at the dam sites in spite of the conservation measures which are restricted only to written notice boards on the dam sites. Although, fishing is strictly prohibited for a distance of 500 metres above and the same distance below the dam site but in practice fishing is done, by unscrupulous elements, at the dam site itself. It is very necessary that strict vigilance is made to enforce the law strictly and, in addition, there should be wide-spread propaganda for this fact and also for creating a healthy public opinion and public education on fishery conservation.

Alternative Means to Save Fishery

In the absence of proper means for the migration of fish across the dams and weirs and also in the absence legislative measures to check other irregularities and drawbacks, the opinion of Raj (1917) may be worth trying particularly to save important fishery of the Mahseer and labeos in the foot-hills of Himalaya. Pisciculture may be an appropriate means to keep the dwindling fishery at a firm pace. For this a series of hatcheries and rearing tanks, with appropriate facilities needed by the fish, will have to be constructed along the rivers for the culture of affected fishes.

Table—I
Comparison of Food Values of Fish, Wheat & Rice
(Based on the information given by Hora, 1948)

	Proteins	Calories	Fat	Iron	Calcium	Vitamin B-1	Riboflavin	Nicotin Acid	Carbo-hydrates
Fish/ounce	3.1 gm.	14	0.2 gm.	0.2 mg.	ug.	10 ug.	21 ug.	0.2 mg.	0
Wheat/ounce	3.4 gm.	98	0.5 gm.	2.1 mg.	11 mg.	128 ug.	34 ug.	1.4 mg.	-
Parboiled milled rice/ounce	1.8 gm.	98	0.1 gm.	0.6 mg.	3.0 mg.	60.0 ug.	23.0 ug.	0.2 mg.	22.4

10,000 Fish— 10,000 Wheat— 16,600 Rice
Quintals. Quintals. Quintals.

In order to save Hilsa fishery from extermination, at the suggestion of Dr. F. Day, the Madras Government constructed fish passes across anicuts in 1869 but they proved useless and on the report of Sir F.A. Nicholson in 1909, they were abandoned and Hilsa hatchery was established at the lower anicuts.

Since a large number of dams and weirs have been constructed on rivers in India without considering the demands of the fishery of the area and suitable fish ladders or passes have neither been provided nor is there any possibility of constructing them at this late stage, it would be only proper to undertake research on the possibilities of culture of the important commercial fishes in the reservoirs and the connecting waters for commercial exploitation.

Acknowledgement

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Wild Life Biology of Sundarbans

MAN-EATING TIGERS

By

Shri A.B. Chaudhuri, I.F.S

AND

Shri K. Chakraborty, W.B.S.F.S.

It is a well known axiom in West Bengal that all tigers of Sundar bans are man-eaters. The authors Chaudhuri and Chakraborty (1972) made useful revelations on the behaviour pattern of the Sundarbans tiger with the aid of factual study which are summarised as follows:

(i) The tigers operate actively for human prey between 7 a.m. and 9 a.m. in the morning and 3 p.m. and 5 p.m. in the afternoon. 80% of the casualties occur within these four hours .

(ii) Most of the victims age range between 35 and 45 years.

(iii) The death figures fluctuate year to year in a particular block; this may be due to (a) migration of the man-eaters from Block to Block, or (b) the urge for human flesh changes year to year indicating rhythm in the behaviour pattern of tigers.

In this connection it is perhaps indicated that "Endogenous periodism" is manifested in tigers as in other animals. Just as colour changes in the fiddler crab are synchronized to dial or tidal cycles, the behaviour pattern so far as human kill is concerned seem to be similarly synchronized; there is some rhythm in their behaviour pattern as evident from graphs displayed in Cheetal, Vol. 15, No. 1.

(iv) The tigers that operate at night and pick up men from their boats are most dangerous and cunning. The following incident will clearly explain how they are agile, cunning, strong and have achieved adaptability:

Shri K. Chakraborty the junior author witnessed how a tiger fought a party of nine crew in a big launch for about two hours and then got into a dingi. It was in 1969 when Shri Chakraborty was crossing a big river near sea coast found a tiger in the mid stream. He in his big motor launch 'Banashree' intercepted the tiger. Then began a battle in which the animal was on defence with all his strength, wits, agility, capacity to manoeuvre against the offensive attack with firearms, pointed bamboo poles, stones and every iron rod, bar etc. which were available in the launch. The tiger fought the on-slaught avoiding direct hits and continued the battle for ninety minutes. It held the pointed bamboo poles hurled at him between one of the fore paw and molar and canine

teeth only to reduce them to blunt and brushy form. Attempts to lasso it also failed, the animal having promptly used his paw and dodged. The tired and exhausted animal at last sought shelter in the attached dingi (small boat) and relaxed. It was a sophisticated acrobatic feat that enabled the 400 pound animal into a light boat. The body completely stretched was brought to the surface of water, a sudden jerk and twist followed and the animal was on the boat that did not tilt even slightly. This is like an able olympic high jumper who twists the body in air. This fact explains how a man-eater mounts a boat without being detected till it picks up a victim and plunges back into water. The animal relaxed in the boat for about an hour having found all the occupants of the launch exhausted, frightened, without any ammunition and completely unnerved. The crew kept the animal at safe distance by tying another long rope with the original one. Shri Chakraborty then decided to drag the dingi to the timber coupe where he could seek the help of a Ranger to take appropriate steps. Suddenly a blast of wind came and the boat capsized. The tiger, now well rejuvenated, in a tremendous spurt of an olympic athlete swam to the shore, glanced a victorious glance at Shri Chakraborty, and then vanished in the world's densest jungle.

(v) In order to explain the behaviour pattern of tiger human casualty ranging 11 years is furnished in a statement as follows:

Casualty among professional men

Year	Honey	Fishing	Timber trader	Others	Total
1963-64	10	13	3	15	41
1964-65	7	9	3	5	24
1965-66	9	20	2	15	46
1966-67	9	18	4	5	36
1967-68	13	13	2	13	41
1968-69	19	11	13	8	51
1969-70	11	12	6	3	32
1970-71	7	16	1	4	28
1971-72	13	9	—	—	22
1972-73	2	9	1	4	16
1973-74	8	2	1	—	11
Total	108	132	36	72	348

Having thoroughly studied the behaviour pattern of tigers in the Sunderbans and in view of heavy casualties suffered among professional men it was desired to make an effort to reduce the death rate.

The authors are of opinion that nothing fruitful can be achieved as the permit holders are extremely poor and cannot make their boats secure enough to protect them from tigers at night; secondly, they surrender to "Vanamata", the forest Goddess, who they think, is their sole protector; thirdly, they have to collect fish, honey etc. in a short time and have to take the risk.

However strenuous and difficult it was the authors made it a point to warn all the permit holders about the most vulnerable time and age to which they should be very particular. This had salutary effect and the death came down to minimum in the history of Sundarbans during 1970-71, 1971-72 and 1972-73. Death of the honey collectors had been 16-17 on an average during 1965-66 to 1971-72. This came down to 2 in 1972-73 and slightly increased to 7 in 1973-74.

Casualty figures furnished below will show that since 1969-70 Matla Block has been the most vulnerable Block; Arbesi Block has turned next vulnerable as may be seen from the figures of 1972-73. Chamta, once the most dreadful Block has not recorded many kills since 1968-69. In 1968-69 altogether 17 persons were killed at Chamta. Katuajhuri Block recorded 11 casualties in the year 1949-50.

Casualty in Matla and Arbesi (April to December)

Year	Number of kill	In how many blocks the kill occurred	Maximum casualty in a single block
1969-70	17	11	3 in Matla
1970-71	13	4	7 in Matla
1971-72	20	5	10 in Matla
1972-73	16	5	8 in Arbesi
1973-74 (part)	10	5	3 in Arbesi and 3 in Chamta.

(vi) Latest casualty figures also justify the authors preliminary findings as follows:

(a) Age class of persons killed by man-eaters from 1969-70 to 1972-73 are

16-25 years	... 13 nos.
26-35 years	... 12 nos.
36-45 years	... 26 nos.
46-55 years	... 15 nos.
56-65 years	... 9 nos.

(b) Time of kill from 1969-70 to 1972-73 was as follows :

7 a.m. to 9 a.m.	... 24 casualties
10 a.m. to 2 p.m.	... 12 casualties
3 p.m. to 5 p.m.	... 23 casualties
8 p.m. to 10 p.m.	... 7 casualties

From the figures it is clearly seen that the death rate was reduced considerably and by proper contact with the permit holders it can be reduced still further. Low casualty during 1971-72 and 1972-73 supports the findings of the authors.

It seems that the tigers become active in a particular Block in a particular year and there might be some sort of rhythmic periodicity in their actions and it might be possible to predict when and where the tigers would be active against men. This is a difficult study but the authors are still continuing their studies.

The Mechanics of Snakes

By

T.S.N. MURTHY,

Zoological Survey of India, Madras-4.

For all living things, life is a constant struggle for survival and food. This is all the more so for lowly serpents which are enemies of man, feared everywhere, molested and persecuted mercilessly. But few of us know about the amazing structural capabilities and skeletal peculiarities the snakes are endowed with which they continue to hold their own in a hostile world for many more years to come.

Locomotion

Snakes are limbless but for faint traces of a pelvis and hind limbs retained as vestiges in Pythons and Boas. They 'walk' on their ribs, swim and grip by tail and climb up on broad scales. Snakes do not possess a breastbone to hamper their movements. The suppleness and strength of the backbone makes it easy for a snake to negotiate and seek escape through pits and narrower surfaces.

Taste, Eye and Ear

Taste in snakes is poor but this is compensated by a strong sense of smell. The harmless tongue protruding out of the snake's mouth is but a delicate organ for picking up senses of the outside world to be transmitted in. In addition, snakes also have a pair of structures known as Jacobson's organs, their function being to appreciate the nature of odorous particles transmitted by the tongue.

The eyes of snakes are lidless and fixed with an unblinked stare. To substitute the loss of eyelids, a scale on the head is modified as a transparent covering to protect the eyes. It appears as if a snake put on goggles.

Snakes are proverbially deaf. They are devoid of the intricate apparatus of hearing. But vibrations through solid objects reaching their skin act as ample warnings of danger. We are still in the dark as to snakes being capable of hearing sounds in the air. When a reputed Indian Herpetologist, Col. Wall made some experiments several years ago to test the hearing powers of snakes he chose the Indian Cobra for this purpose because of its quick

reaction to stimuli by raising its hood and expanding it. The results of these experiments showed that no attention was paid by the snake to loud noises but even when blindfolded with adhesive tape, it reacted immediately to a foot step of a person walking nearby or moving a chair. It is thus proved that snakes can hear only earthborne sounds.

Dentition

We marvel at the amazing gorging powers of snakes which brings us to the unique mechanism of a snake's skeleton—its jaws. The bones of a snake's jaws are attached to one another and to the skull by means of elastic ligamentous tissue which permits much distortion and wide expansion of the mouth. This, together with the expansion of ribs and body wall, allows for the passage of a prey that far exceeds the size of the head.

Snakes do not masticate their food after swallowing the prey as a whole. The juices secreted in the stomach of a snake can digest skin, feathers and bone.

Snakes are amazing fasters. They do not eat everyday. A big meal will last one several days or weeks. The snakes at the Zoo are usually fed once a week. It is recorded that a rock Python once lived for 2 years and nine months without eating in a Paris Zoo.

Snakes are devoid of any sweat glands and the outer skin does not grow. But the skin is peeled off (Ecdysis) every two months or earlier even to the scales over the eyes which is more than a bath for them. After shedding its skin, the snake looks bright and becomes alert.

The masterpiece of a snake's protective devices is, of course, its fang. The fang is a modified tooth and can compare well with a hypodermic needle. Like the surgical instrument, it is used only when necessary, for snakes strike only as a means of defence or to kill prey.

A snake's teeth are broadly of three types—the solid, grooved and canaliculate. Solid teeth are found in all the primitive and vast majority of harmless species. Grooved teeth are found only in the upper jaw at the hinder end and snakes possessing them are called back-fanged snakes. The venom of this type of fang is not toxic to man although it may be fatal to smaller vertebrates and so such snakes are semi-poisonous. It is among the division, Proteroglypha, or front-fanged that we meet the killers—Cobras, Kraits, Vipers and Sea Snakes. Many of them bite with a bull-dog tenacity; they force their fangs into the flesh of the victim with a chewing action. The poison fangs of a snake are shed periodically and replaced immediately by "reserves".

Snakes even possess peculiar mechanical devices with which they warn away their enemies. For instance, the awe-inspiring sight of a Cobra's hood is only used for frightening the enemies. The hood of a Cobra is put up by flattening of the ribs on the head when the animal is annoyed or excited. Then there is the warning "rattle" of the American pit viper. The rattle is composed of a series of rounded, horny sheaths at the base of the tail and the snake vibrates it at high speed to intimidate its enemies even from a distance of 16 feet. Snakes are cold blooded. Their temperature varies with external conditions. Because their temperature is low, they can live in debris and under-stones for hours and days.

Thus the snake which we consider as a symbol of evil may yet hold its own mainly due to the unique machinery of its skeleton and other structural peculiarities.

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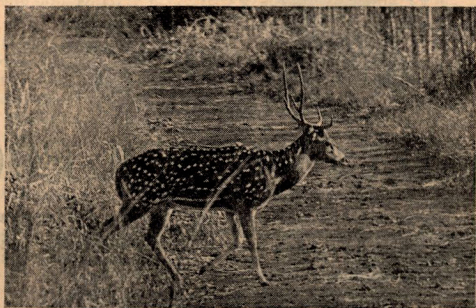
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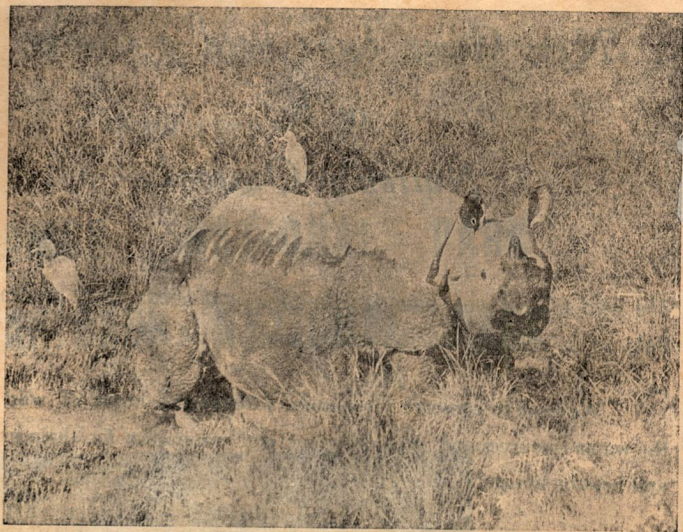
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